



# SURGERY

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### With International Abstracts of Surgery

*Official Journal of the American College of Surgeons*

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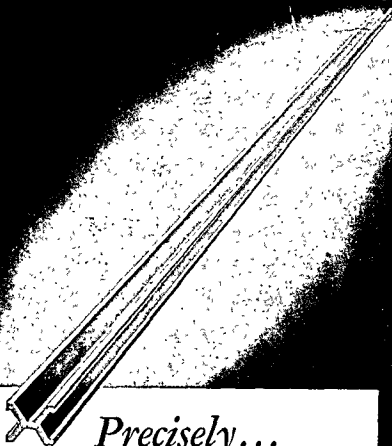
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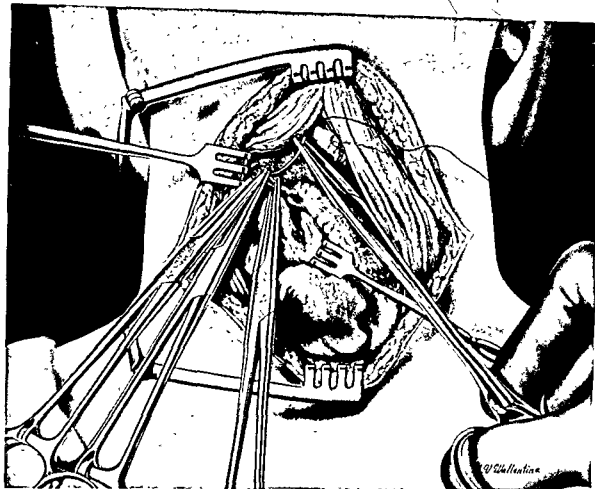
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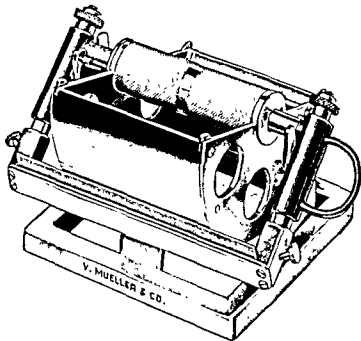
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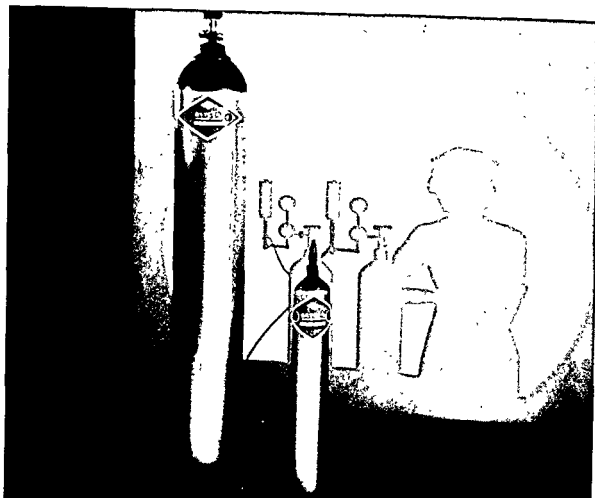
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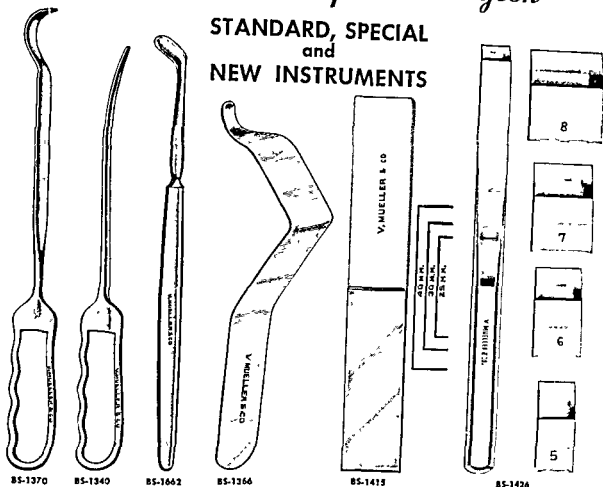
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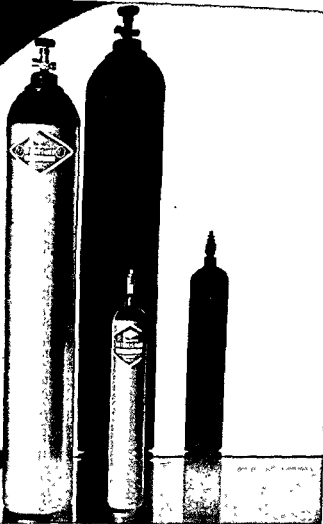
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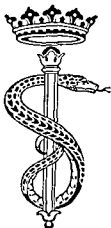
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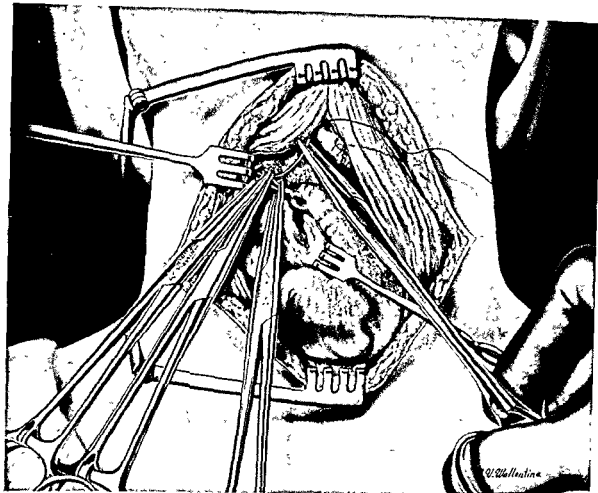
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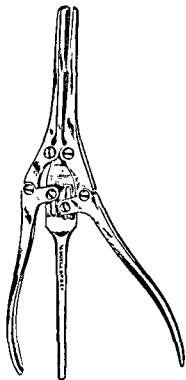
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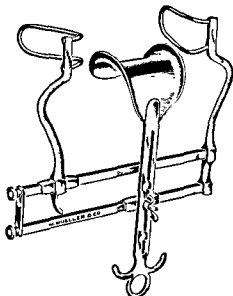
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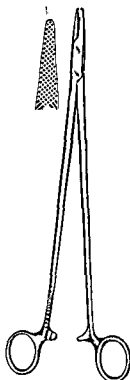
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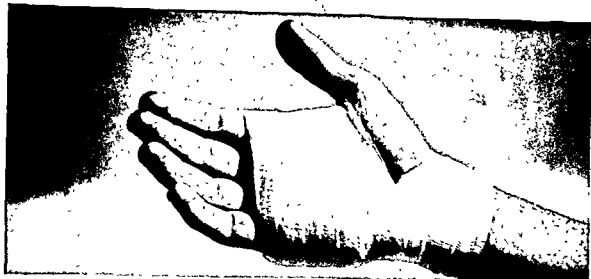
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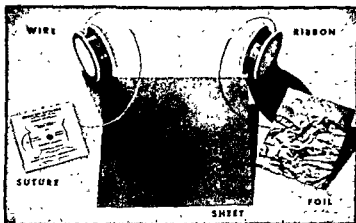
# TANTALUM *in Traumatic Surgery*

## A SURGEON'S REPORT

"I have used tantalum wire suture material on all our hand injury cases for the past year and have a large series of them to look back upon. I have used the tantalum wire for both buried and cutane-

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\*Olson, C. T.: "The Place of Tantalum in Surgery," Industrial Medicine, 13, 917, November, 1944.



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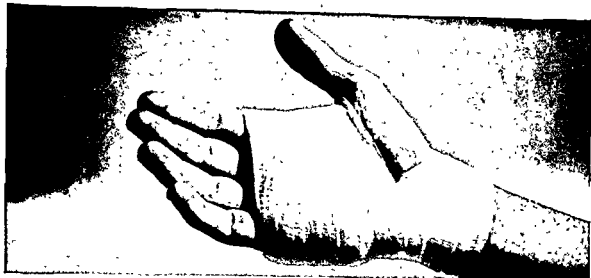
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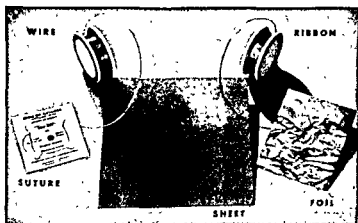
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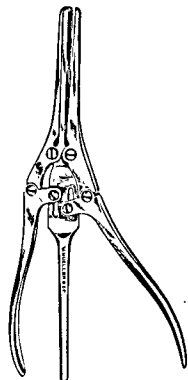


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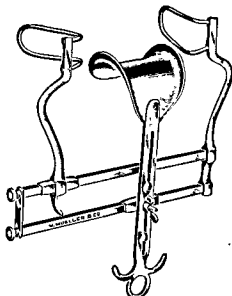
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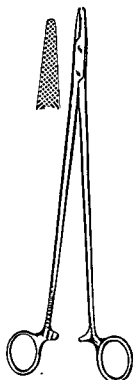
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# SURGERY



## GYNECOLOGY AND OBSTETRICS

VOLUME 83

JULY, 1946

NUMBER 1

### LOCAL CHEMOTHERAPY OF WOUNDS Tissue Toxicity of Certain Antibacterial Substances

EDWARD L. HOWES, M.D., F.A.C.S., New York, New York

**I**N this investigation the tissue toxicity of some of the newer antibacterial substances is compared with their speed of action and fate in the tissues. The substances tested were streptomycin, sulfamylon<sup>1</sup>, calcium penicillin, parachlorophenol, tyrothricin, and zephiran.<sup>2</sup> The results of local chemotherapy with two of the antibacterial substances of low toxicity and rapid bacteriocidal action will be presented.

The antibacterial substances were tested for toxicity against cells growing in tissue culture, for the amount of irritation caused to the conjunctiva of the eye, for their capacity to damage subcutaneous blood vessels, for their capacity to destroy muscle on injection, to cause peritoneal adhesions, and to influence the rate of wound healing. Their antibacterial activity was tested in the presence of blood against the common bacteria found in the flora of wounds.

#### TISSUE CULTURE TESTS

The tissue culture tests demonstrated the concentration which was toxic when constantly in contact with cells. The method employed has previously been described by Simms (12).

The work described in this paper was done under a contract, recommended by the Committee on Medical Research, between the Office of Scientific Research and Development and Columbia University. Tissue culture work was done by Dr. Henry Simms, Ph.D., and Dr. Mary Parsley, Ph.D.; technical assistance furnished by Janice Kleinsorge and Joan Kennedy.

<sup>1</sup>4-amino, 2-methyl benzene sulfonamide hydrochloride = Marfanil = homosulfanilamide = Mesudin.  
<sup>2</sup>Benzyl trialkyl ammonium chloride.

Its advantage is that the results were obtained against adult cells which possess growth requirements differing from embryonal cells.

Epithelial cells and fibroblasts from adult animals were incubated in serum ultrafiltrate for 24 hours to keep them alive and they were then transposed to chicken plasma to grow. Some were grown directly in plasma. The substances to be investigated were added in minute amounts either to the serum ultrafiltrate or the plasma as indicated in Table I. If the substance was toxic, none of the cells grew or grew very poorly. If the substance was partially toxic, the growth of the cells was poor.

*Results of tissue culture tests.* Bacteriocidal amounts of most of the known antiseptics killed cells. The complete data on these tests will be reported elsewhere by Simms and Parsley (11). Calcium penicillin, 100 units per cubic centimeter, was inert. Bacteriocidal concentrations of streptomycin and sulfamylon were only mildly inhibitory to cells. Streptomycin, 100 units per cubic centimeter, was inert, while 200 units were only moderately inhibitory.

Previously, streptothricin was found to be slightly more toxic; 100 units being slightly inhibitory, while 200 units were definitely toxic.

Sulfamylon, 0.15 per cent, was only moderately inhibitory while 0.1 per cent was toxic. On the other hand, zephiran (.01%), parachlorophenol (.001%), and tyrothricin (.05%) were toxic to cells.

TABLE I.

Substances	Stimulating	Inert	Inhibitory	Toxic
Sulfamylon in $\frac{UF}{3}$			05%—A 46	01%—A 0
in $\frac{PI}{3}$			05%—F 44 01%—E 40	
Streptomycin		.02% ( $\frac{100 u}{ml}$ )	.02% ( $\frac{200 u}{ml}$ )	
Streptothricin			.02% ( $\frac{200 u}{ml}$ ) A 37	02% ( $\frac{200 u}{ml}$ ) A 1
Tyrothricin				05%
Parachlorophenol				01% E, F 0 001% A 0
Calcium penicillin in $\frac{UF}{3}$		.03% ( $\frac{100 u}{ml}$ ) A 90 .003% ( $\frac{100 u}{ml}$ ) A 120 E 117		
in PI			.03% ( $\frac{100 u}{ml}$ )	
Zephiran				.02% A 0 01% A 0
Sulfadiazine in $\frac{UF}{10}$	085% A 175 05% A 131			
in $\frac{X}{6}$			.085% A 56 05% A 53 005% A 71	

UF = serum ultrafiltrate  
PI = plasma  
X6 = a special physiological solution  
u = units

Key: A = aorta fibroblasts  
E = epithelial cells  
F = fibroblasts  
O = no growth, over 125 stimulating, 125 to 75 = inert, 75 to 25 inhibitory, 25 to 0 = toxic

Thus zephiran, parachlorophenol, and tyrothricin, in the dilutions employed to inhibit the growth of bacteria, were toxic to cells when constantly in contact with them. Penicillin was inert while streptomycin and sulfamylon mildly inhibited the growth of cells.

## EYE TESTS

The eye tests indicated the concentration of agent which would be irritating to the delicate tissues of the conjunctiva. Vasodilatation, edema, and exudate are produced if the substances are irritating. Contact with the tis-

suess is short in this test and there is considerable dilution but the tissues are very sensitive.

Two or three drops of the solution to be tested (Table II for concentrations) were placed in the eye of a rabbit and a similar amount of saline in the opposite eye. The immediate reaction of blood vessels was noted together with their condition 30 minutes later. Twenty-four hours afterward, the state of the blood vessels and the amount of edema were observed.

*Results of eye tests.* The results are shown in Table II. At their antibacterial concentrations nearly all the substances and sometimes even the saline caused some immediate injection of the blood vessels. Parachlorophenol (0.25%) caused more immediate redness than the other agents. At the end of one-half hour most of the treated conjunctivae had returned to their normal appearance, while those treated with calcium penicillin (200 units per c.c.), tyrothricin (0.05%) and parachlorophenol (0.25%) still showed slight redness. After 24 hours no abnormal reactions were observed with any of the antibacterial agents, indicating that except for causing a transitory reaction, none of them really injures the conjunctiva of the eye.

## MUSCLE INJECTIONS

The injections in muscle indicated the capacity of the agent to cause an inflammatory reaction and fibrosis in muscle—the period of contact with the tissues was the interval between the time of injection and the absorption or neutralization of the agent.

Five to 10 cubic centimeters of the various antibacterial substances was injected in the muscles of the leg of the rabbit. To eliminate error in locating the site later, the needle was inserted anteriorly to the bone of the hind leg at a definite distance above the knee joint. In the opposite leg, the same amount of saline was injected. Twenty-four hours and 48 hours later the animals were killed and the tissues were examined grossly and microscopically. In order to be certain of the identification of the injected site in the animals living for 4 days and 1 week, a long incision was made under aseptic precaution through the skin of the back. The points of injection were marked with silk

# HOWES: LOCAL CHEMOTHERAPY OF WOUNDS

TABLE II.—EYE TESTS—5 DROPS EACH EYE

Date	Substance	Immediate reaction	½ hour	Reaction after 24 hours
10-10-45	Ca penicillin 200 u. per c.c.			
6-1-45	Streptomycin 200 u. per c.c.	Slight blanching	Very slightly red	Normal
6-1-45	Sulfamylon 5%	Very slight reddening	Normal	Normal
6-1-45	Streptomycin and sulfamylon mixture†	Very slight reddening	Normal	Normal
10-1-45	.05% Tyrothricin	No change	Very slight redness	Normal
10-1-45	.25% p chlorophenol	Very slight redness	Still slightly red	Normal
10-1-45	.5% p chlorophenol	Marked redness	Very slightly red	Normal
10-2-45	Saline	Whole eye very red	Normal	Normal
Typical reaction in all rabbits		No reaction or very slight redness	Normal	Normal

†Consisted of 200 units of streptomycin per c.c., 5 per cent of sulfamylon, and ½ per cent of sodium benzoate.

ligatures in the fascia overlying the back muscle. Then the skin was resutured. The tissue immediately beneath the sutures was subsequently removed for biopsy.

**Results of muscle injections.** The results are shown in Table III. Zephiran produced edema, leucocytosis, and deposition of fibrin for the first 48 hours, and after 96 hours streaks of mononuclear cells could be found. Tyrothricin produced exudation and edema and finally fibrosis. Calcium penicillin produced some slight edema and exudation for the first 24 hours although thereafter no tissue reaction was observed. Streptomycin and sulfamylon produced a reaction comparable to calcium penicillin. A mixture of streptomycin and sulfamylon with sodium benzoate produced no more edema or leucocytosis than the single substances. Parachlorophenol produced a slight amount of edema and infiltration for 24 hours. After 48 hours the myosin seemed coagulated and after 1 week degenerated muscle was considerable fibrosis. Saline occasionally produced a slight exudation after 24 hours. Phenol and iodine, which were used for basis of comparison, produced frank necrosis and suppuration.

In summary, tyrothricin, zephiran, and parachlorophenol produced considerable tissue reaction and fibrosis while streptomycin and sulfamylon, calcium penicillin produced tissue reactions of such low grade that parental administration of these substances would be tolerated.

## INSTILLATION IN PERITONEAL CAVITY

Only the substances which produced minimal tissue reactions were injected into the peritoneal cavity. Twenty cubic centimeters of calcium penicillin, sulfamylon, streptomycin, and the combination of the last two with sodium benzoate, were injected into the peritoneal cavity of the rabbit. Ten days later the peritoneal cavity was examined and was found to be free of adhesions.

## DESIRABLE ANTIBACTERIAL PROPERTIES FOR LOCAL CHEMOTHERAPY

For local chemotherapy antibacterial substances should possess prompt bacteriocidal activity in the presence of blood. Regardless of how soluble the antibacterial substance might be, the portion of it in solution is the important component. It affects the growth of the bacteria and causes the inflammatory reactions. This portion is either quickly absorbed or neutralized while the insoluble residue is treated as a foreign body. When neutralized, this fraction loses its antibacterial properties. The portion in solution may be adsorbed temporarily on the tissue, yet thereafter rapid absorption occurs unless it has sufficient toxicity to produce an edema. Then, however, neutralization occurs.

The insoluble residue of the antibacterial substance is encapsulated by a foreign body reaction. This process of encapsulation is distorted and delayed in direct proportion to the amount of inflammatory reaction produced by the portion in solution.

# SURGERY, GYNECOLOGY AND OBSTETRICS

## TABLE III.—RESULTS OF INJECTION INTO MUSCLE

Substance	Microscopic appearance			
	After 24 hours	After 48 hours	After 96 hours	After a week
Calcium penicillin 200 u. per c c.	Slight edema and a considerable number of leucocytes	No change.	No change	No change
Sulfamylon 5%	Occasional leucocytes. Minimal reaction. Fibrin deposits	Very slight change. Coagulation of muscle substance into irregular small pink globules. A few more leucocytes than in ordinary muscle	Slight infiltration of round cells	No change
Streptomycin	Some leucocytes. Slight edema	Nothing to distinguish it from saline. Some leucocytes	Very tiny area of new granulations between muscle fibers	No change
Streptomycin 200 u. per c c	No evidence of injection	No change	No tissue reaction	No change
Sulfamylon 5%	Marked edema and infiltration of leucocytes. Fibrin	Some edema and a number of leucocytes. Fibrin	Streak of mononuclear cells	Fibrosis. Giant cells. Degeneration of muscle
Sodium benzoate 1/4%	Marked edema and a considerable number of leucocytes. Fibrin	Edema and a few leucocytes. Muscle looks coagulated	Considerable destruction of muscle with replacement by fibroblasts, mononuclear and capillaries. Occasional giant cells and dust of leucocytes	
Zephiran 1:1000	Marked edema and a considerable number of leucocytes. Fibrin	Some leucocytes coagulated. Muscle looks coagulated	Streak of muscle coagulated	Fibrosis. Many mononuclear cells. Marked degeneration of muscle
Tyrosin 0.5%	Edema and some leucocytes. Considerable fibrin			
Parachlorophenol .15%			Muscles are coagulated and necrotic. Gross destruction of muscle	
Iodine 3.5%			Extensive destruction of muscle with fibroblasts, granulation and round cell infiltration	
Phenol 1%		Slightly more infiltration of round cells. Very slight change in muscle substance		
Sulfamylon 5%		Some infiltration of round cells	Small area of separation of muscle fibers with many fibroblasts and young granulations	No change
Normal saline	Minimal reaction			

Conversely, because of the rapidity of absorption and neutralization of the portion in solution, antibacterial agents which possess only bacteriostatic activity and therefore require considerable time to act, are not useful for local chemotherapy unless the soluble portion can remain adsorbed for a long time without neutralization, or the parent substance dissolves slowly, or a base is employed slowly to release the soluble portion. The last two possibilities usually lead to continuing inflammatory reaction and fibrosis and what is more common, extrusion of the offending substance.

### BACTERIOLOGICAL TESTS

To find out how a short contact with the antibacterial substances would kill bacteria, the filter paper, blood agar plate method of testing antiseptics, was adapted for our pur-

poses (2). A 24 hour culture of the particular bacteria to be investigated was streaked on a blood agar plate and the plate was incubated for 3 hours. Then a piece of filter paper dipped in a solution of the antibacterial substance was placed on the agar for 10 minutes. Ten minutes was selected because this length of time is seldom exceeded in carrying out local chemotherapy. The control area was treated with saline or not at all. The plate was then incubated for 24 hours.

Bacteria grew abundantly over the control areas and over the rest of the plate where there was no antibacterial substance, but not in the area of contact with the filter paper containing the antibacterial substance. This area remained clear. Considering that bacteria were smeared over the entire surface of the plate and that they were either growing or were

TABLE IV.—SULFAMYLON 5 PER CENT—  
10 MINUTE CONTACT

Date of test	Strain of bacteria	Inhibition of growth in area contacted by paper	Inhibition zone about this area
5-17-45	Staphylococcus (coagulase positive)	++++	+
5-19-45	Staphylococcus (coagulase positive)	++++	+
6-12-45	Staphylococcus (coagulase positive)	++++	++
6-12-45	Staphylococcus (coagulase positive)	++++	++
6-22-45	Staphylococcus (coagulase positive)	++++	++++
8-14-45	Bacillus coli	++++	++++
8-24-45	Bacillus proteus	++++	+
8-14-45	Bacillus pyocyaneus	++++	o
8-14-45	Bacillus pyocyaneus	++++*	o
10-10-45	Hemolytic streptococcus	++++	o
10-10-45	Green streptococcus	++++	++

\*Overgrowing colonies after 24 hours.

kept alive by incubating their failure to develop further in the area of contact with the agent indicated that the substance was definitely bacteriocidal. If the antibacterial substance caused hemolysis of blood this property could also be detected by the method.

About the area where the filter paper was placed there also occurred a clear zone where the bacteria did not grow. This zone varied in extent with the degree of bacteriocidal activity of the substance tested, with the sensitivity of the bacteria to the antibacterial substance and with the capacity of the antibacterial substance to diffuse through the agar.

The sensitivity of penicillin and streptomycin to acidity and dilution has been demonstrated (13, 10). Streptomycin has its optimal antibacterial activity at pH 7.8 and changes to the acid side detract from this activity. It is completely destroyed at pH 2 as is penicillin. No such information is available for sulfamylon. Hence these points were determined by the method employed.

**Results.** The results which are to be described are for the conditions of the experiment and should not be interpreted for different concentrations or longer contacts with the bacteria.

Sulfamylon (5%) killed staphylococci, the hemolytic and green streptococci, *Pseudomonas aeruginosa*, *Escherichia coli*, and proteus

TABLE V.—STREPTOMYCIN 200 UNITS PER  
CUBIC CENTIMETER 10 MINUTE CONTACT

Date of test	Strain of bacteria	Inhibition of growth of bacteria in area contacted by paper	Inhibition zone about this area
5-17-45	Bacillus coli	++++	++
6-12-45	Bacillus coli	++++	++
6-22-45	Bacillus coli	++++	+
6-13-45	Bacillus proteus	++++	+
6-22-45	Bacillus proteus	++++	+
5-17-45	Bacillus proteus	++++	++++
6-12-45	Staphylococcus (coagulase positive)	++++	++
6-22-45	Staphylococcus (coagulase positive)	++++	++++
6-12-45	Bacillus pyocyaneus	++++*	o
6-22-45	Bacillus pyocyaneus	++++*	o
5-17-45	Bacillus pyocyaneus	++++	o
10-10-45	Streptococcus hemolyticus	o	o
10-10-45	Green streptococcus	o	o

\*Spread in from edges.

‡Overgrown in 36 hours.

(Table IV). With all these bacteria there was a zone of inhibition about the area of contact with the paper except with the hemolytic streptococcus and pyocyaneus (*Pseudomonas aeruginosa*). Pyocyaneus was killed only within the area of contact with the paper and quickly grew in again from the edges over the cleared area.

After a similar period of contact, streptomycin, 200 units per cubic centimeter (Table V), killed the staphylococcus, pyocyaneus, *Escherichia coli* and proteus. Pyocyaneus again grew back over the cleared area and more rapidly than with sulfamylon. Streptomycin was ineffective against the strains of hemolytic and the green streptococci employed. There was luxuriant growth in the area of contact with the paper.

Originally, the hypothesis was entertained that sulfamylon and streptomycin should be combined on the thesis that the former would destroy gram positive bacteria while the latter would destroy the gram negative ones. Actually when used in this manner both seem to have about the same range of bacteriocidal activity except for the streptococci. Both streptomycin and sulfamylon killed strains of staphylococci, the *Escherichia coli*, and pro-

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Sodium benzoate 1/2%	Marked edema and a considerable number of leucocytes. Fibrin	Edema and a few leucocytes. Muscle looks coagulated	Considerable destruction of muscle with replacement by fibroblasts, mononuclear and capillaries. Occasional giant cells and a lot of leucocytes	Fibrosis. Giant cells. Degeneration of muscle
Zephiran 1:1000	Marked edema and a considerable number of leucocytes. Fibrin	Some leucocytes coagulated. Muscle looks coagulated	Streak of muscle coagulated	Fibrosis. Many mononuclear cells. Marked degeneration of muscle
Tyrosin 05%	Edema and some leucocytes. Considerable fibrin		Muscles are coagulated and necrotic. Gross destruction of muscle	
Parachlorophenol 25%			Extensive destruction of muscle with fibroblasts, granulation and round cell infiltration	
Iodine 3 5%				
Phenol 1%		Slightly more infiltration of round cells. Very slight change in muscle substance		
Sulfamylon 5%		Some infiltration of round cells	Small area of separation of muscle fibers with many fibroblasts and young granulations	No change
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6-13-45	Staphylococcus (coagulase positive)	++++	++
6-22-45	Staphylococcus (coagulase positive)	++++	++++
8-14-45	Bacillus coli	++++	++++
8-14-45	Bacillus proteus	++++	+
8-14-45	Bacillus pyocyaneus	++++	o
8-14-45	Bacillus pyocyaneus	+++*	o
10-10-45	Hemolytic streptococcus	++++	o
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6-12-45	Bacillus coli	++++	++
6-22-45	Bacillus coli	++++	+
6-13-45	Bacillus proteus	++++	+
6-22-45	Bacillus proteus	++++	+
5-17-45	Bacillus proteus	++++	++++
6-12-45	Staphylococcus (coagulase positive)	++++	++
6-22-45	Staphylococcus (coagulase positive)	++++	++++
6-12-45	Bacillus pyocyaneus	+++*	o
6-22-45	Bacillus pyocyaneus	+++*	o
5-17-45	Bacillus pyocyaneus	+++†	o
10-10-45	Streptococcus hemolyticus	o	o
10-10-45	Green streptococcus	o	o

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The results for the effects of changes in acidity and dilution on sulfamylon are recorded in Tables IX and X.

*Comment on bacteriological test.* Although the filter paper was in contact with the blood agar plate and the bacteria for 10 minutes, actually the antibacterial substance was absorbed into the agar and it was in contact with the bacteria for a much longer period of time. How long a contact is required to kill bacteria is difficult to state for the answer depends in part on the number of bacteria present and whether they are in the lag or growth phase of their development. Tests of the phenol coefficient type showed that penicillin was capable of destroying many more bacteria than either streptomycin or sulfamylon when the bacteria were sensitive to its action. Yet, a definite period of time was required for penicillin to act. For example, when penicillinase was added to a mixture of bacteria and penicillin, 4 hours' contact was found to be the period required for the penicillin to kill the bacteria. Similar substances are not available to determine the duration of contact necessary for the other antibacterial substances to act.

Clinically, no resistant bacteria should be encountered. These tests are important, therefore, only because they show that more strains of bacteria are susceptible to action of streptomycin and sulfamylon than to penicillin and that the combination of the two encounters very few resistant strains. Combinations with penicillin should be tested for their capacity to destroy various strains of bacteria.

Obviously, sulfamylon is the only drug which continues to be effective with markedly increased acidity. The change of susceptibility of *Escherichia coli* is of interest (Table X).

*Influence on rate of wound healing.* These tests studied the influence of the antibacterial substance on the character and length of the exudative phase of healing of the open wound and on the rate of regeneration of new tissue. The conditions which the antibacterial substance encounters on the open wound are very complex. In the open wound there is dilution of the agent by the secretions of the wound and there is constant absorption of the antibacterial substance from the surface of the wound



Fig. 1. a. Sodium sulfadiazine. b. Streptomycin. c. Sulfamylon plus streptomycin.

especially after granulations have formed. For these reasons much higher concentrations can be employed, or to state the situation conversely, granulations are not as easily damaged by antibacterial agents as are fresh tissues. Further because of the absorption, the antibacterial agents must be supplied to the wound in a base which acts as a reservoir for the material. This base must not only be innocuous but it must maintain the proper physical state of the tissues. To answer these requirements cholesterolized petrolatum was employed for the experiment though only about 2 per cent of the original content of antibacterial substance seeps from this base. On the other hand, the cells are continuously in contact with this amount of the active agent as in the tissue culture method of testing.

The open wound was made on the rabbit's ear leaving a small island of skin in the center. It was photographed every day. The character of the exudate, of the granulations, the time when the island began to grow, and the rate of its growth were observed.

The results are shown in Table XI.

These animals were killed at the end of an experiment to determine if absorption of the antibacterial substance from the wound caused damage to the excretory and neutralizing tis-

## SURGERY, GYNECOLOGY AND OBSTETRICS

TABLE VIII.—OTHER ANTISEPTIC AGENTS—10 MINUTE CONTACT

Agent	Date of Test	Strain of bacteria	Inhibition of growth of bacteria in area contacted by paper	Inhibition zone about this area
			o	o
Sodium sulfadiazine 5/10%	6-6-45	Staphylococcus	++	o
Sodium sulfadiazine 5/10%	6-12-45	Staphylococcus	++++	++
Tyrosine (1%)	10-26-45	Green streptococcus	++++	++
Iodine (1/4%)	6-6-45	Staphylococcus	++*	o
Phenol (1%)	6-12-45	Staphylococcus	++++	+
Phenol (1%)	5-17-45	Bacillus coli	++	o
Phenol (1%)	6-12-45	Bacillus proteus	++++	o
Phenol (1%)	6-12-45	Bacillus pyocyaneus	++++	++
Phenol (1%)	6-1-45	Staphylococcus	o	o
Tyrosine (1%)	8-18-45	Bacillus pyocyaneus	++	o
Tyrosine (1%)	10-26-45	Hemolytic streptococcus	o	o
Tyrosine (1%)	10-26-45	Bacillus coli	o	++
Tyrosine (1%)	10-26-45	Bacillus proteus	++++	++
Tyrosine (1%)	10-26-45	Green streptococcus	++++	o
Tyrosine (1%)	10-26-45	Staphylococcus	++	-1
Tyrosine (1%)	3-27-45	Bacillus pyocyaneus	++	-2
Zephiran 1:1000	8-18-45	Bacillus coli	+	++
Zephiran 1:1000	8-18-45	Bacillus proteus	++++	+++
Zephiran 1:1000	8-18-45	Hemolytic streptococcus	++++	-
Zephiran 1:1000	10-26-45	Green streptococcus	++	-
Zephiran 1:1000	10-26-45	Bacillus proteus	++++	+
Zephiran 1:1000	10-26-45	Bacillus pyocyaneus	++++	o
P-chlorophenol (1%)	5-15-45	Staphylococcus	++++	o
P-chlorophenol (1%)	5-15-45	Bacillus pyocyaneus	++	o
P-chlorophenol (1%)	5-15-45	Staphylococcus	o	o
P-chlorophenol (1%)	10-24-45	Green streptococcus	o	o
P-chlorophenol (1%)	10-26-45	Hemolytic streptococcus	o	o

\*Overgrowth from edges  
 †Few colonies  
 ‡Slight hemolysis

sucs, such as the liver and kidney. Specimens were taken for biopsy.

## RATE OF WOUND HEALING

**Results.** The average index obtained was 7.5 days, i.e., for the length of time required for the exudative phase and to produce 2 millimeters of new tissue. The best rate ever obtained was 5.6 days. As can be seen from the Table XI, 400 units of streptomycin combined with 5 per cent sulfamylon definitely slowed the rate of healing. Parachlorophenol gave only a fair rate and tyrosine was just average and produced a slight exudate. Granulations remained thin with it. On the other hand, excellent healing rates were obtained

with sulfamylon, 5 per cent and 1 per cent, and streptomycin, 200 units per cubic centimeter, and with the combination of these. Calcium penicillin gave only an average healing rate while sodium penicillin definitely retarded the rate of healing.

**Discussion.** A pattern is presented for investigating the merits of chemotherapeutic substances to use locally.

Tests will ultimately have to be conducted to determine the concentration of penicillin, sulfamylon, and streptomycin which will cause tissue reactions. Then the antibacterial activity of a slightly weaker solution will have to be studied. For example, 300 units per cubic centimeter of streptomycin or an amount

TABLE IX.—THE EFFECT OF DILUTION ON ANTIBACTERIAL ACTIVITY OF SULFAMYLON

Date	Strain of bacteria	Inhibition in area of contact	Inhibition zone about this area
		Sulfamylon .05%	
9-25	Staphylococcus (coagulase positive)	o	o
9-25	Bacillus coli	o	o
		Sulfamylon .15%	
9-25	Staphylococcus (coagulase positive)	o	o
9-25	Bacillus coli	o	o
		Sulfamylon 1%	
9-25	Staphylococcus (coagulase positive)	++	o
9-25	Bacillus coli	o	o
		Sulfamylon 2%	
10-1	Staphylococcus (coagulase positive)	++++	++
10-4	Staphylococcus (coagulase positive)	++++	+
10-1	Bacillus coli	+++	o
10-4	Bacillus coli	o	o
		Sulfamylon 3%	
10-1	Staphylococcus (coagulase positive)	++++	+++
10-4	Staphylococcus (coagulase positive)	++++	+
10-1	Bacillus coli	++++	+++
10-4	Bacillus coli	++	o
		Sulfamylon 4%	
10-1	Staphylococcus (coagulase positive)	++++	++++
10-4	Staphylococcus (coagulase positive)	++++	++++
10-1	Bacillus coli	++	o
10-4	Bacillus coli	++++	++++

between the nontoxic 200 units per cubic centimeter and the toxic 400 units per cubic centimeter should be tried. In fairness also, it should be said that streptomycin is still in the early stages of development and products of increased purity and less tissue toxicity will undoubtedly be produced. These purified samples will have to be tested. Several reports (3, 9, 10), have been made that massive doses of penicillin produced inflammatory changes and tissue necrosis locally, but the dilution employed was not mentioned. Meddewar reported that crude penicillin (kind not mentioned) in a dilution of 1:1600 was toxic to fibroblasts after 48 hours. Herrell and Heilman found that above 500 micrograms per cubic centimeter penicillin showed cytotoxicity for lymphocytes. In other words, there is a concentration where penicillin becomes toxic. The strongest concentration of

sulfamylon which will cause tissue reaction is not even suspected. Sulfamylon hydrochloride solution 5 per cent used in these experiments had a pH of approximately 5.2 and this acidity can be neutralized without loss of antibacterial power. Theoretically, the neutralized solution should be less toxic also.

Historically, many antibacterial substances have failed as local chemotherapeutic agents because the complete pattern of requirements has not been met, *i.e.*, they were toxic or they did not act quickly in the presence of blood and pus or they were readily influenced by other changes in the environment. For example, iodine and mercuric chloride possessed none of the necessary characteristics except the capacity to destroy bacteria. More recently the sulfonamides failed because all were slow to act and were inhibited by para-amino benzoic acid. Moreover, when used as pow-

TABLE X.—THE EFFECT OF pH. ON ANTIBACTERIAL ACTIVITY OF 5% SULFAMYLON

Date	Strain of bacteria	Inhibition in area of contact	Inhibition zone about this area
		pH 5.1	
10-5	Staphylococcus (coagulase positive)	++++	+
10-8	Staphylococcus (coagulase positive)	++++	o
10-5	Bacillus coli	o	o
10-8	Pyocyanus	++++ overgrowth in 48 hours	++++ overgrowth in 48 hours
10-5	Pyocyanus	++++ overgrowth in 36 hours	++++ overgrowth in 36 hours
		pH 3.8	
10-5	Staphylococcus (coagulase positive)	++++	++++
10-8	Staphylococcus (coagulase positive)	++++	+++
10-5	Bacillus coli	o	o
10-5	Pyocyanus	++++ overgrowth in 36 hours	o
10-8	Pyocyanus	++++ overgrowth in 48 hours	+++ overgrowth in 48 hours
		pH 2.0	
10-5	Staphylococcus (coagulase positive)	++++	++++
10-8	Staphylococcus (coagulase positive)	++++	+++
10-5	Bacillus coli	o	o
10-5	Pyocyanus	++++ overgrowth in 36 hours	+++ overgrowth in 36 hours
10-8	Pyocyanus	++++ overgrowth in 36 hours	+++ overgrowth in 36 hours

ders, as they were, the more soluble sulfanilamide was toxic while the less soluble sulfathiazole and sulfadiazine, remained as foreign bodies which were ultimately extruded from the tissues. All sulfonamides caused some reinitiation of bleeding in the wound, a property which sulfamylon possesses only to a minor degree. Some slight bleeding was observed in one instance when a very large quantity of the 5 per cent solution of sulfamylon was put into a peritoneal cavity studded with tubercles.

Penicillin has been used locally to treat staphylococcus and streptococcus skin infections and for instillations into empyema cavities. For local skin diseases penicillin is usually applied in the form of an ointment. Dry calcium penicillin powder is irritating to the surfaces of fresh wounds. Sodium penicillin is more irritating than calcium and even 200 to 500 units per cubic centimeter in saline causes a burning sensation when applied locally. No cases could be found in which clean contaminated wounds were flushed with a saline suspension of penicillin to prevent infection be-

fore suturing. There is no reason why the solution of penicillin nor it combined with streptomycin or neutralized sulfamylon should not be added to the irrigating fluid used in débridement to increase the antibacterial range of that fluid. Dry penicillin powder has been placed in wounds to be sutured and in open wounds. Those which are to be left open, especially those with granulation, tolerate dry penicillin well but dry powders of any of antibacterial substances, even when they exhibit low toxicity, should not be used in wounds which are to be sutured. A saturated solution results which may be toxic as the work with penicillin suggests (5, 3, 10), and besides saturated solutions are not needed for antibacterial action.

Although penicillin has been repeatedly injected in lesser concentrations into muscle for parenteral administration, injections of a solution of it about an area for the prevention or treatment of an infection has not been practiced. In the frankly infected wound, penicillin is not effective because of the excessive

amounts of dead tissue present, and penicillin is destroyed in the presence of gram negative bacteria. The prediction can be made also that streptomycin and sulfamylon will not be successful in the local treatment of the purulent wound even though both substances have wider range of antibacterial activity than does penicillin. Local chemotherapy will not be successful in the presence of slough until there is also a chemotherapy of slough. Yet, the published reports on the local use of sulfamylon are optimistic.

Nearly all bacteriologists who have worked with sulfamylon have proposed that the drug should be used for local treatment of wounds, but only Mitchell, Reese, and Robinson have published their results. They applied powdered sulfamylon to 22 purulent wounds including 4 burns. In one-third of the cases, no growth could be obtained on cultures after 4 to 12 days' treatment, and 70 per cent showed improvement. The German Army apparently made extensive use of sulfamylon for the local treatment of wounds, but their records are not available.

In experimental animals, Hamre, Walker, Durham, Van Dyke, and Rake showed that sulfamylon is one of the most effective agents for the local treatment of gas gangrene although they used comparatively small amounts of the drug. They recommended a clinical trial of local treatment and also noted that its acute and chronic toxicity was of low order. The *in vitro* activity of sulfamylon against the anaerobic gas forming micro-organisms has been confirmed by others (9, 14). There is universal agreement in the literature that sulfamylon is not inhibited by para-amino benzoic acid (1, 8) and that unlike penicillin it is not destroyed by penicillinase.

These experiments also demonstrated that changes in the acidity of the wound would not destroy the activity of sulfamylon except against *Escherichia coli*. Locally, a concentration of 3 per cent or greater must be maintained.

The local use of streptomycin is reported for the first time in this publication. It was used in combination with sulfamylon. Sutured wounds and certain types of open wounds were successfully treated. On the other hand,

TABLE XI.—INDEX OF WOUND HEALING\*

Animal No.	Amount in cholesterised petrolatum	Index	Remarks
569	1% sulfamylon	6.8	Excellent healing
573	5% sulfamylon	6.9	Excellent healing
571	200u streptomycin, 5% sulfamylon applied daily to wound. Overlaid with calcium penicillin	7.3	Excellent healing
577	5% sulfamylon + 200u streptomycin	5.7	Excellent healing
574	5% sulfamylon + 400u streptomycin	10	Scum-like exudate. No growth on island of epithelium. Granulations are thin.
585	Penicillin 200u per c c	7.0	Excellent healing
586	Streptomycin 200u per c c	6.4	Excellent healing
422	1% zephiran 1:2000	6.6	Excellent healing
410	1% zephiran 1:2000	6.8	Excellent healing
440	Tyrosinase 0.05%	7.0	Average healing produced some exudate
584	Parachlorophenol 0.25%	7.0	Fair healing
415	Sulfadiazine 1%	6.1	Excellent healing

\*Index = days required for exudative phase plus days required to produce a millimeter of new epithelium. Average index = 7.3. Best rate ever obtained = 5.6 days.

local applications of the combination, like penicillin, were not too successful in ridding the open wound of infection. Why the combination was successful in certain types of wounds and not in others had best be explained.

Local chemotherapy of the open wound is a more complex problem than chemotherapy of the sutured wound. Some of the difficulties encountered in treatment of the open wound have been pointed out already. Besides the open wound is recontaminated with bacteria at every dressing, the bacterial flora changes and the bacteria develop fastness for the chemotherapeutic agent. Then slough must be liquefied for slough is a nutrient and protector of the bacteria. On the other hand, in the sutured wound the bacterial contamination is complete at the time of suturing. The tissues are freshly injured and easily injured again by the agent. The chemotherapeutic agent can be used once only at the time of closure of the wound.

Among open wounds and inflammatory conditions which were free of slough, 68 wounds, burns, and rectal conditions were treated with the solution of sulfamylon and streptomycin. Satisfactory results were obtained without



# THE GASTRIC DIGESTION OF LIVING TISSUE

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**A**LTHOUGH the digestion of dead animal tissue ingested as food is well understood, the digestion of living tissue, especially autogenous tissue, remains obscure. Why the stomach does not digest itself during life is a question that has never been answered satisfactorily. John Hunter postulated a "vital principle" in all living tissues which prevents digestion, but the presence or nature of such a "principle" has not been demonstrated. Obviously different tissues vary in their ability to withstand the corrosive action of gastric juice. Secretions which are quite innocuous in the healthy stomach may simply irritate the walls of a gastric fistula but cause painful erosions of the skin at the mouth of the fistula. The question of autodigestion has long interested physicians, partly as a matter of scientific curiosity, but chiefly because it is related intimately to such clinical problems as the pathogenesis and healing of peptic ulcer, the violent peritonitis which follows acute perforation, perforations which invade the pancreas or liver, anastomotic jejunal ulcer, gastroduodenal fistula, and the destructive effects in the lungs of aspirated gastric contents.

Claude Bernard in 1859 showed that the leg of a live frog thrust through a fistula into a dog's stomach is soon digested away. The same is true of a rabbit's ear (8). Observers have not been in agreement, however, regarding the digestion of experimental autoplasmic grafts. Katzenstein, Kathe, Best, and others claimed that living spleen, intestine and omentum implanted in a dog's stomach are digested, but opposite results were obtained by Holtz, Licini, and Tietze (6). Mann and others (2, 6, 7) have shown that patch transplants of jejunum, so placed that only the mucosa of the intestine is exposed to gastric contents, remain unchanged for long

periods of time (as long as 1½ years) unless they are situated at the lesser curvature, in which case ulcers often develop in the grafts.

A more detailed study of autodigestion was made by Dragstedt and his associates (3, 4). These investigators reported that the intact spleen, kidney, and pancreas implanted in openings in the anterior wall of the stomach or duodenum of dogs are not digested even after several weeks, and they concluded that these living organs resist the digestive action of normal gastric and duodenal contents. Patch transplants of small intestine were found to be digested, however, by the pure secretions of an isolated stomach or a Pavlov pouch. So also was the spleen. It was observed, furthermore, that intestinal loops implanted with the serosal surface exposed to gastric juice undergo partial digestion with the formation of smooth round perforations. Dragstedt and his coworkers decided that the outer layers of the intestinal wall are less resistant than the mucosa to the digestive action of gastric juice.

The present investigation has extended those observations. Our early experiments showed that small windows in the normal canine stomach heal so rapidly that the digestive effects of gastric juice are masked by the processes of repair; consequently, in most of our experiments large openings were made through which tissues or organs were deeply implanted in the lumen of the stomach, thus insuring prolonged full exposure to gastric contents. Special pains were taken to preserve normal or adequate blood supply in the tissues tested.

About 135 dogs were used in these experiments. Stock laboratory animals were employed, operations being done aseptically under pentobarbital sodium anesthesia. Fine cotton thread was used for ligatures and sutures. Water and food (dog pellets) were permitted freely after operation. The animals were explored surgically or were sacrificed after various intervals. Autopsies were per-

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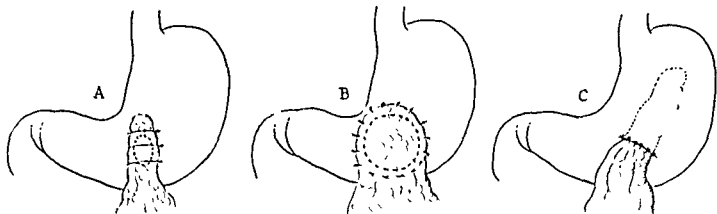


Fig. 1. Three methods used to expose living omentum to the action of gastric juice: A, a small oval window in the stomach covered with a tab of omentum; B, a large

window covered with a thin patch of omentum; C, a large tongue of omentum inserted through a window into the lumen of the stomach.

abdominal wall. In both animals the omentum still embedded in the abdominal wall appeared perfectly normal on gross and microscopic examination.

Finally, small pieces of omentum were grafted on the serosal surface of the anterior gastric wall so as to receive their blood supply entirely from it. Some of these free grafts had the appearance of normal fatty omental tissue, while others were (by design) more or less fibrosed; but all were living and healthy. The transplants were subsequently turned into the lumen of the stomach on pedicle flaps of gastric wall (Fig. 6). In this way living omentum, having undergone various degrees of fibrosis, was exposed to gastric juice. In most instances these omental grafts were digested in from 6 to 18 days, although a small island of fat surrounded by fibrous tissue was found in one instance after 44 days. It was not determined whether the fibrous grafts were digested more or less rapidly than the more normal fatty tissue.

It may be concluded, therefore, that healthy living omentum is digested when deeply implanted in the stomach, but placed patch-like over a gastric window it becomes fibrosed and suffers only superficial digestion.

2. *Digestion of living intestine.* The digestion of part of an isolated segment of jejunum which protruded into the stomach has already been noted. In that experiment it was obvious that all the layers of the intestinal wall had undergone digestion, although the destructive process ceased abruptly at the level of the gastric wall (Fig. 4 B).

An isolated piece of jejunum with intact mesenteric blood supply was sewed patchlike in a gastric window so that only its mucosa was exposed to gastric juice (Fig. 7). This experiment has been done many times by earlier investigators and our results are similar to theirs. No changes were detected in this flat jejunal implant after as long as 262 days.

It was found, furthermore, that after a graft of this sort had "taken" its mesentery could be divided without injury to the patch. When, however, the jejunal transplant was invaginated into the gastric lumen (a) by infolding that part of the stomach with sutures, or (b) by turning in a pedicle flap of gastric wall including the transplant (as in Fig. 6), digestion of the jejunal mucosa occurred, although adjacent comparable gastric mucosa remained normal.

Intact loops of jejunum and ileum were also implanted in the stomach so as to expose the serous surface to gastric juice. When small windows were used, relatively little digestive action was observed and the gastric defects healed rapidly. When the loops were deeply implanted in large windows, however, (Fig. 8) perforation and digestion of the exposed intestinal wall regularly occurred. Areas of necrosis and perforation were observed as early as 2 days after implantation; after 11 days extensive necrosis and multiple perforations were found; after 27 days digestion of the exposed wall was nearly complete with formation of smooth gastrointestinal mucosal junction. Figures 9 and 10 show clearly one stage in that digestive process.



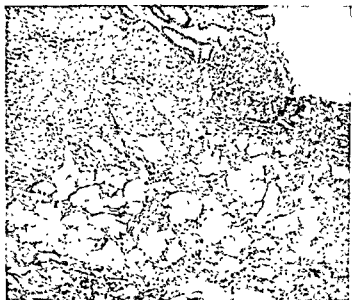


Fig. 3. Photomicrograph of an omental implant after 21 days, showing the edge of the residual crater illustrated in Figure 2. Proliferating gastric epithelium is seen in the upper right-hand corner, as well as a small quantity of necrotic debris about to be sloughed into the lumen of the stomach. The base of the ulcer shows superficial necrosis, cellular infiltration, granulation tissue, and fibrosis; the underlying omentum is fibrotic.

later after having passed bloody stools. The implanted kidney of this animal showed extensive necrosis and digestion, and the stomach and intestines were full of blood. The second dog was very ill when sacrificed 4 days after operation. A similar picture was presented of necrosis and digestion of the implant with hemorrhage into the stomach. The remaining 3 dogs, sacrificed on the 14th, 16th, and 29th days, respectively, showed partial digestion of the implant, extensive fibrosis of the exposed parenchyma, and areas of hemorrhage, infection, and necrosis (Fig. 17).

After many failures we succeeded in one dog in implanting part of the inferior lobe of the left lung in the stomach which had first been herniated through the diaphragm. The omentum, drawn up with the stomach, was tucked around the implant to prevent leakage. This animal, which remained healthy, was sacrificed on the 15th day. There had been no slipping of the structures or leakage of gastric contents. The implanted lung was found to have been digested entirely away, leaving a healing gastric stoma around a circular necrotic crater. Two other dogs, dying 2 days after operation from leakage of gastric contents and infection, showed only atelectasis

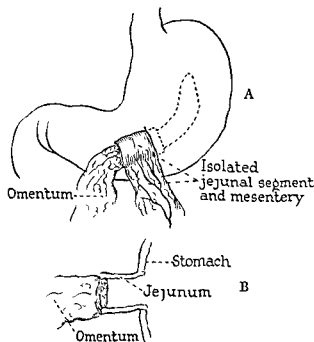


Fig. 4. Omentum implanted after it has been threaded through a cuff of jejunum. One edge of the jejunal cuff was pushed into the gastric window and fastened there so as to protect the omentum from strangulation. A, the original implant; B, a sagittal view of the result after digestion had occurred.

and hyperemia of the implant and inflammation of its pleura.

4. *Digestion of living connective tissue.* In 8 dogs large round holes were made in the anterior gastric wall and the margins of the holes were sutured to the parietal peritoneum so as to expose the abdominal wall itself to the digestive action of gastric juice. After 24 hours there was hyperemia of the exposed parietal peritoneum; after 9 days the peritoneum had disappeared and there was fibrosis and digestion of the abdominal wall; after 36 days fibrosis and digestion were more marked with the production of an ulcer a few millimeters deep, the margins of which showed

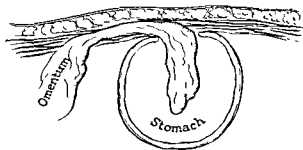


Fig. 5. A tongue of omentum implanted after passage through a tunnel in the abdominal wall. The margins of the gastric window were sewed to the parietal peritoneum so that the omentum could not be constricted by the stomach.

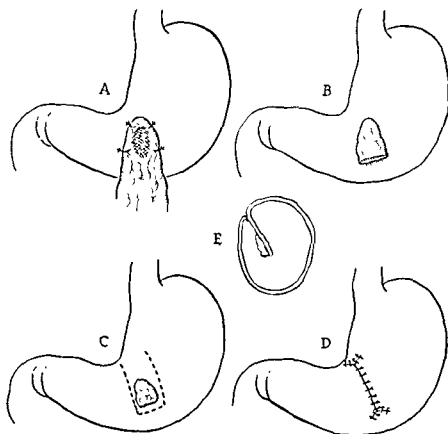


Fig. 6. Steps in the preparation and implantation of free living grafts of omentum: A, omentum fastened to the gastric wall covering a scarified area; B, parent omentum cut away after the graft had taken; C, 1 or 2 weeks later, a pedicle flap of gastric wall cut so as to include the graft; D, invagination of the flap and its parasitic graft and closure of the defect; E, sagittal view of the implant.

healing and active proliferation of gastric epithelium. One dog after 64 days had a large deep ulcer involving the fascial and muscular layers of the abdominal wall.

By a multiple-stage operation a long pedicle flap of skin was raised from the anterior abdominal wall and the free end of the flap was placed in the peritoneal cavity. A week later this flap, which appeared quite healthy, was implanted in the stomach by making a large hole in the anterior gastric wall and sewing the margins of the hole to the abdominal wall around the flap, as was done with the omentum in Figure 5. In this way we insured good circulation of skin while exposing it directly and continuously to gastric juice. One such dog sacrificed 11 days after implantation showed partial digestion of the flap, especially its subcutaneous tissue. In another dog more advanced necrosis and digestion were seen

after 18 days, although the hair on the graft had grown appreciably during the period of implantation. Histologic examination of these specimens shows that epidermis is more resistant than the dermis or subcutaneous tissue to the digestive action of the gastric juice. In a third dog sacrificed after 21 days the flap had digested away entirely.

We also planted free whole thickness skin grafts, 1 to 2 centimeters in diameter, on the anterior serosal surface of the stomach and on the parietal peritoneum near the stomach. The skin took readily on these surfaces. The grafts on the stomach were implanted by turning in pedicle flaps of gastric wall (as in Fig. 6), and the grafts on the parietal peritoneum were exposed by suturing the margins of a gastric window to the abdominal wall around them (as in Fig. 5). Partial digestion of these skin grafts was noted as soon as the

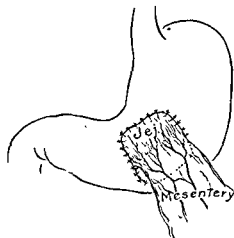


Fig. 7. An isolated segment of jejunum with mesentery attached, opened along its antimesenteric border and sewed patchlike in a large gastric window. The patch is trimmed to fit the window neatly so that only jejunal mucosa is exposed to the gastric contents.

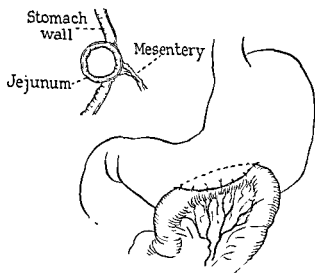


Fig. 8. Deep implantation of small intestine in the stomach. The inset shows a sagittal view of the implant.

12th day after implantation, but islands of residual epithelium could be found histologically even after 2 months.

The ends of the 10th and 11th ribs were freed and brought into the peritoneal cavity; a few days later about 3 centimeters of one or both ribs was implanted in the stomach. Complete digestion of these cartilaginous structures to the level of the gastric stoma occurred in from 12 to 17 days.

5. *Digestion of living gastric tissue.* Small and large areas of gastric mucosa were excised so as to expose the underlying submucous and

muscular coats of the stomach to the digestive action of its own secretions. The smaller denuded areas healed rapidly. One area 1.5 by 2.5 centimeters in size was completely healed in 12 days, leaving only a minute puckered scar. On microscopic examination the muscle underlying this scar appeared perfectly normal. Larger denuded areas, 3 to 5 centimeters in diameter, required 4 to 6 weeks for healing. None of these artificial "ulcers" perforated, but histologic examination showed pronounced fibrous reaction involving the muscle layers. When, however, large portions of the stomach

### Lumen of Stomach

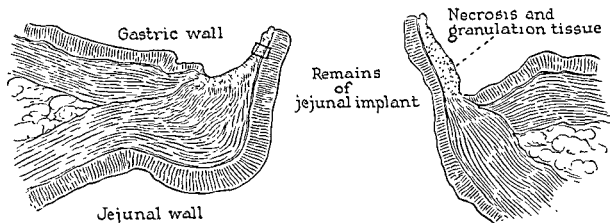


Fig. 9. Sagittal view of a deep jejunal implant after 27 days. Most of the implanted intestine had digested away leaving a large gastrojejunal fistula. The seromuscular surface of the jejunum was much more seriously affected by gastric juice than was the mucous membrane. Microscopic examination of the margins of the fistula showed no proliferative activity on the part of the jejunal mucosa, but on the other hand there was no evidence that the intestinal mucosa had been digested until its underlying wall was destroyed and its blood supply cut off. The area within the square is shown in greater detail in Figure 10.



Fig. 10. Jejunal wall 27 days after implantation. Normal mucosal glands and submucosa are seen on the right, but the seromuscular layer has almost entirely disappeared. A thick layer of typical granulation tissue is seen on the left. This surface was exposed directly to the gastric contents.



Fig. 11. Section showing violent reaction of the serous surface of the colon after several days' exposure to gastric juice. The seromuscular coat is acutely inflamed with extensive necrosis. The margins of a perforation, not seen in this view, gives no evidence of proliferative activity of intestinal epithelium.

(e.g., the entire antrum and prepylorus) were deprived of mucous membrane, healing was delayed in some instances for several months. Multiple small deep ulcers were occasionally seen in these unhealed defects, and one dog died on the 49th postoperative day from perforation and peritonitis.

In 2 animals short wide flaps of gastric wall, 2.5 by 5 centimeters in size, were raised,

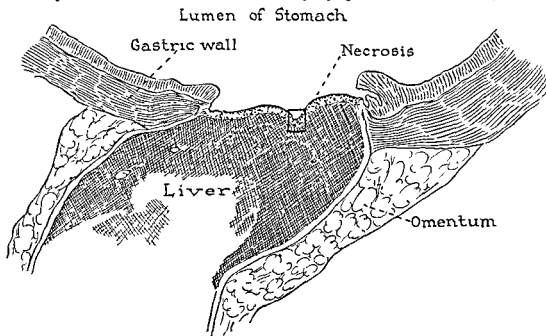


Fig. 12. Result of a deep liver implant after 26 days. The portion of the lobe, several centimeters in length, which protruded into the stomach, had digested away, leaving a shallow crater with a necrotic base. The surrounding gastric epithelium shows moderate proliferative activity.

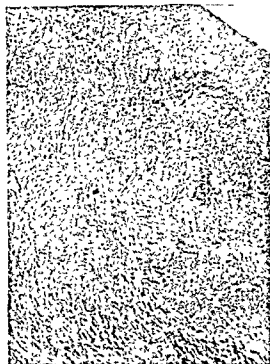


Fig. 13. Photomicrograph of the necrotic base of the crater illustrated in Figure 12. Beneath the layer of necrosis seen in the upper right-hand corner, is a zone of fibrosis, granulation tissue, and cellular infiltration. Liver cells appear at the bottom of the picture. A small developing abscess may be observed in the lower right hand corner of the picture.

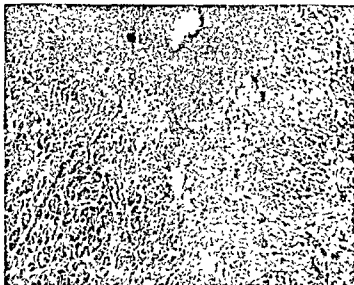


Fig. 14. Photomicrograph of a pancreatic implant after 24 days. Frank necrosis may be seen in the upper part of the field; below, islands of pancreatic cells in various stages of deterioration are separated by fibrous and granulation tissue.

stripped of mucosa, and were then sutured back in place. In this way we attempted to expose to digestion a portion of gastric wall which lacked a protective covering of mucosa, had been subjected to a certain amount of operative trauma, and had had its circulation somewhat disturbed. These defects healed at about the same rate, however, as the denuded areas described in the preceding paragraph. There was pronounced fibrosis of the exposed muscle, but no real ulceration or perforation.

Finally, in a series of 11 dogs we turned pedicle flaps of gastric wall into the lumen of the stomach (Fig. 18). The flaps were so cut that they received an abundant blood supply from the vessels of the lesser curvature, shown by free bleeding from the tips and sides. Two of these flaps had the mucosa removed and consequently were composed of only the outer layers of the gastric wall. They were completely digested in 2 to 3 weeks. The flaps which contained mucosa showed early digestion of the serosa and muscle and delayed digestion of the mucosa; in fact, the mucous membrane had a tendency to enfold and pro-

tect its supportive structures (Fig. 18). In 2 animals in which the mucosa completely enveloped the other coats, the flap after 3 to 4 weeks had the appearance of a cone of mucosa projecting into the gastric lumen. These poly-poid structures remained unchanged as long as the dogs were observed (33 and 91 days). When this protective envelopment by the mucosa failed to occur or was incomplete, the pedicle flaps disappeared in 2 to 4 weeks, leaving ulcers in the stomach wall at the site of the base of the flaps. In these animals it is



Fig. 15. Photomicrograph of an implanted spleen after 19 days. Digestion had occurred to the level of the gastric stoma. A thin zone of acute inflammatory reaction, hyalinization, and necrosis overlies the splenic parenchyma which retains its structural characteristics.



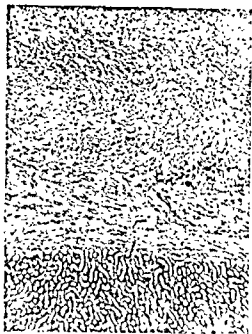


Fig. 16. Photomicrograph of a kidney 7 days after tangential implantation in a gastric window. Great thickening and fibrosis of the capsule are noted, but the parenchyma is intact and healthy.

probable that the seromuscular layers of the flaps were destroyed and that the mucosa, deprived of support and circulation, thereupon underwent digestion also.

#### OBSERVATIONS

It may be questioned whether additional factors such as strangulation, infarction, infection or autolysis may not have contributed to the results which we have called gastric digestion. The question of constriction actually arises only in the case of solid tissues or organs where more or less unyielding structures are implanted through a gastric window which in time undergoes contraction. In those preparations care was taken to avoid constriction at the time of implantation, and subsequent microscopic examination of the implanted tissues shows the vessels in most instances to be normally filled with blood. Moreover, abnormal cellular changes are found as a rule only at or near the corroding surface and not in the body of the implant as would be expected if the circulation of the entire implant were compromised. Since our implants were all made in the normal fasting acid stomach, a high percentage of infections would

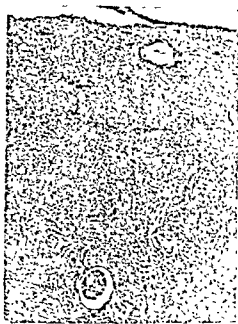


Fig. 17. Photomicrograph which shows the digesting surface of a deeply implanted kidney. Superficially necrosis and acute inflammatory reaction are noted; more deeply can be seen hemorrhage, fibrosis, cellular infiltration, and granulation tissue, as well as a degenerating glomerulus and the remains of collecting tubules.

not be expected and in fact were not found. Leucocytic infiltration and abscesses were observed in some of the implants, but that was exceptional. Histologic examination also appears to rule out autolysis as a primary factor in the so called digestion since there was no generalized deterioration of cells throughout the implant. The evidence seems fairly conclusive, therefore, that living tissue of all sorts may actually be digested in the stomach, either directly or after necrosis has occurred, in the absence of contributing factors such as strangulation, infection and autolysis.

Living tissues vary in susceptibility to gastric digestion. Judged by the time required for digestion when placed in the stomach tissues may be arranged tentatively in order of resistance of digestion. Most susceptible are the seromuscular coats of the intestine and gall bladder; next, omentum and cartilage; then kidney, spleen, lung, liver, and pancreas; and most resistant of all, fibrous connective tissue, skin, and intestinal mucosa.

The only tissue which appears to be completely immune to ordinary gastric digestion

is the epithelium of the stomach. Thin sheets of regenerating gastric epithelium, even those which seem to be poorly supported and nourished by underlying structures, show no signs of injury from gastric juice. The reason for this immunity is not clear. It has been suggested that the presence of a protective coat of mucin prevents digestion, but Dragstedt and his associates state that the most advanced cells in the proliferative process may be entirely devoid of mucin. It is noteworthy that tissues, once covered by regenerating gastric epithelium, are protected from digestion. This is an important feature of the process of repair in the stomach.

An impression gained from this study is that fibrosis, a reaction most strikingly seen in the omentum, hinders digestion and therefore acts as a protective mechanism for more highly differentiated tissue. Granulation tissue seems to provide an even more resistant surface. It is important to note in this connection that certain tissues respond to the presence of acid pepsin with considerable fibrous reaction and round cell infiltration, whereas others undergo disintegration and digestion at the surface without much reaction.

Tissues also vary in the type of reaction to gastric juice. Serous surfaces in general become acutely inflamed with leucocytic infiltration and necrosis, as in Figure 11. The omentum and the capsules of liver, spleen and kidney usually respond with excessive amounts of fibrosis, as in Figures 3 and 16. The parenchyma of solid viscera characteristically present complex pictures of fibrosis, hemorrhages, cellular infiltration, and necrosis (Figs. 13, 14, 15, and 17). Some tissues, muscle for example, tend to produce granulation tissue at the corroding surface, as in Figure 10. Epidermal surfaces seem to erode slowly with little or no cellular reaction.

Organs and tissues which project into the lumen of the stomach are much more rapidly and completely digested than are those placed tangentially in a gastric window. An attractive conjecture is that deep implants, lacking adequate protective coats of mucin, are subject to digestion, whereas tangential implants and residual craters of digested implants are protected from the full corrosive effects of

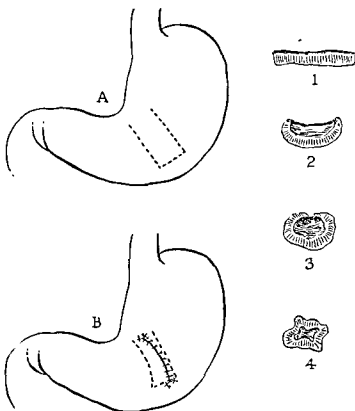


Fig. 18. Method of turning in a pedicle flap so as to expose the structures of the gastric wall to the digestive action of its own secretions. The small figures illustrate the tendency of such flaps to curl, the more resistant mucosa enveloping the less resistant seromuscular layer.

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It should be noted finally that a number of our animals appeared toxic, some were quite ill in fact, during the period of necrosis and digestion of the implants; but these animals recovered full health after the necrotic tissue had disappeared. This phenomenon was observed particularly after implantation of intestines, gall bladder, and solid organs.

#### SUMMARY AND CONCLUSIONS

An experimental study has been made to determine whether or not living tissues are susceptible to ordinary gastric digestion. Many different tissues, including omentum, intestine, liver, gall bladder, pancreas, spleen, kidney, lung, cartilage, skin, and even the gastric wall itself, were subjected to gastric digestion in healthy dogs. The test was made by means of implanting living tissues and organs in the lumen of the stomach or by insuring prolonged surface contact with gastric secretion.

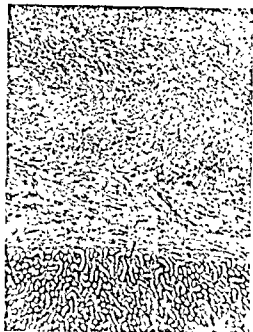


Fig. 16. Photomicrograph of a kidney 7 days after tangential implantation in a gastric window. Great thickening and fibrosis of the capsule are noted, but the parenchyma is intact and healthy.

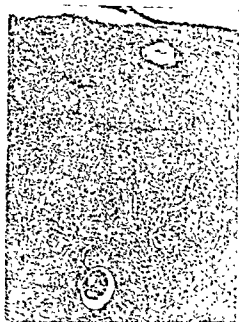


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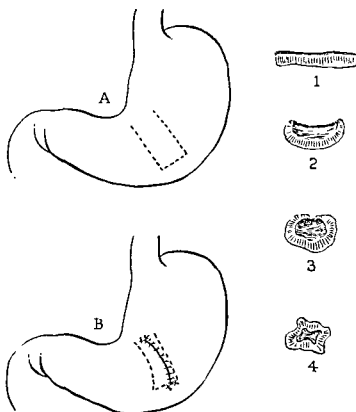


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Virtually all the tissues and organs so tested underwent digestion. There is evidence that this digestion occurred, in many instances at least, in the absence of contributing factors of strangulation of the implant, infarction, infection, or autolysis.

The tissues most rapidly digested were the external coats of hollow organs (intestines, appendix, gall bladder); those most resistant were fibrous connective tissue, skin, and intestinal mucosa. The seromuscular coat of the stomach itself was not exempt from autodigestion. The one tissue which seemed to be immune to ordinary digestion was gastric epithelium.

Organs and tissues projecting into the lumen of the stomach were much more rapidly and completely digested than were those which were placed tangentially in a gastric window.

Living tissues undergoing digestion showed different sorts and degrees of reaction. Serous surfaces in general became acutely inflamed with rapid leucocytic infiltration and necrosis. The omentum and the capsules of liver, spleen, and kidney responded with excessive amounts of fibrosis. The parenchyma of solid viscera characteristically presented complex pictures of fibrosis, hemorrhages, cellular infiltration, and necrosis. Some tissues, muscle for example, tended to produce granulation tissue at the corroding surface. Epidermal surfaces slowly eroded with little or no cellular reaction.

Histologic study suggests that a surface of active fibrosis offers a certain amount of resistance to digestion, that even more opposition is offered by a layer of granulation tissue, and that these surfaces act as barriers to the destructive action of acid chyme. Such tissue responses are probably of practical importance since they serve as protective mechanisms, delaying the progress of corrosion until healing can take place by means of fibrous contraction of the gastric defect and proliferation of gastric epithelium across the base of the ulcer. Once tissues are covered with proliferating gastric epithelium, they appear to be safe from further corrosive action of normal gastric juice.

A number of the dogs appeared toxic during the period of necrosis and digestion of the implants, but recovered full health after the necrotic tissue had disappeared.

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# THE LOCAL APPLICATION OF NITROFURAN COMPOUNDS WITH SPECIAL REFERENCE TO USE ON WOUNDS

M. C. DODD, Ph.D., F. W. HARTMANN, Sc.D., and W. C. WARD, M.S.

IN a previous report (4) a series of nitrofurán compounds was shown to be bacteriostatic and bactericidal for a variety of gram positive and gram negative organisms in low concentrations. Further work has established the fact that the bactericidal activity of several of these compounds is not abolished by the presence of blood or serum.

Previous work has also shown that some of these compounds are nontoxic for laboratory animals in moderately large doses.

These facts suggested the possible clinical use of nitrofurán compounds in the treatment of infected wounds. In order to test the value of this suggestion as far as possible in the laboratory and to provide maximum information to the clinician, an examination was made of the irritant properties, toxicity, and effect on the healing rate of wounds in rabbits produced by the local application of nitrofurán compounds. For this purpose, five of these compounds previously shown to have excellent antibacterial properties *in vitro* were selected. The 5 compounds chosen were—



Solubility  
in water

5-nitro-2-furyl methyl ketone	—R—COCH <sub>3</sub>	1-250
5-nitro-2-furaldehyde semicarbazone	—R—CH=N—NHCONH <sub>2</sub>	1-5000
n-propyl-5-nitro-2-furoate	—R—COOC <sub>3</sub> H <sub>7</sub>	1-10,000
5-nitro-2-furfuryl propionate	—R—CH <sub>2</sub> OOCC <sub>3</sub> H <sub>5</sub>	1-1000
ethyl β-(5-nitro-2-furyl) acrylate	—R—CH=CHCOOC <sub>2</sub> H <sub>5</sub>	1-15,000

The first four may be regarded as derivatives, in the order named, of furan, 2-furaldehyde, 2-furoic acid and 2-furfuryl alcohol, while the last named compound is related to β-(2-furyl) acrylic acid.

The relatively low solubility of four of these compounds in water has already been indicated. For the following experiments they were incorporated into a water soluble base composed of polyethylene glycols (carbowaxes) and propylene glycol.<sup>1</sup> The semicarbazone and the furoate

formed pharmaceutically acceptable preparations in this base while the other three compounds caused a progressive discoloration of the base. However, *in vitro* tests on the discolored products showed no loss of antibacterial activity even after storage for 1 year.

In these experiments this base was found to be quite suitable as a vehicle for the application of these antibacterial compounds. All of the nitrofurán compounds are soluble in the base thus providing a vehicle by which greater concentrations of the compounds could be applied than would be otherwise possible unless the compounds were placed directly on the wounds. In avoiding this latter procedure, a more economical preparation was obtained even though the concentrations used in the base are many times the minimum bactericidal concentrations of the compounds. Keeping in mind that the primary clinical use for these compounds would be in the treatment of infected wounds, a preparation of this kind also avoids the caking and interference with wound drainage so frequently encountered with powdered preparations and heavy ointments. In addition, the slight surface active properties of carbowaxes, plus the fluidity of the preparation at body temperature should provide a mechanism for a maximum of spreading and mixing of the compounds with body fluids even when pus or other organic material is present. Finally, the preparation being washable can be removed readily with water and facilitates observation and redressing of wounds.

The base alone was used as a control in the experiments on the healing rate of treated wounds. It is nonfatty, contains no water, and possesses physical characteristics suitable for use as a vehicle for local application. Extensive work by Smyth and coworkers (13, 14) has demonstrated the lack of toxicity and irritation of the carbowaxes for laboratory animals and that they produced no more irritation in human subjects than such commonly used bases as petrolatum and glycerin. Friedman has shown that carbowax 1500 is also nontoxic for rabbits when given intravenously in large doses. Numerous investigations (1, 6, 7, 10, 16) have been reported on the safety of propylene glycol for human use.

<sup>1</sup>Carbowax 1500—55%  
Carbowax 4000—20%  
Propylene glycol—25%

TABLE I.—IRRITATION TESTS ON HUMAN SUBJECTS WITH FIVE NITROFURAN COMPOUNDS—RESULTS OF EXAMINATION AFTER 6, 24, AND 48 HOURS

Subject	5 nitro-2-furyl methyl ketone 1:500			5 nitro-2 furaldehyde semicarbazone 1:500			n propyl-5-nitro-2 furoate 1:500			5-nitro-2 fur-furyl propionate 1:100			ethyl 8-(5 nitro-2 furyl) acrylate 1:500		
Number	6	24	48	6	24	48	6	24	48	6	24	48	6	24	48
1	—	—	±	—	—	—	—	—	—	—	—	—	—	—	+
2	—	—	+	—	—	—	—	—	—	—	—	—	—	—	+
3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	+
4	—	—	+	—	—	—	—	—	—	—	—	—	—	+	+
5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	+
6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
9	—	—	—	—	—	—	—	—	—	—	—	—	—	—	+
10	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total Reactions	0	0	1	0	0	0	0	0	0	0	0	0	0	1	6

(-) = no skin reaction

++(+) = hyperemia of skin.

## IRRITATION TESTS ON HUMAN SKIN

The five aforementioned nitrofuran compounds were tested for possible irritation effect on human skin. Four compounds, the ketone, semicarbazone, furoate and furylacrylate were used at a concentration of 1:500 in the base, while the propionate was tested at a concentration 1:100 in the same preparation. All five preparations were applied to the forearms of each of 10 volunteers for 2 successive days. Following application, the areas used were covered by small dressings. Sufficient material was applied to insure its presence on the skin for 24 hours. Observations of all areas were made at 6, 24, and 48 hours following application.

Table I shows that none of the five nitrofuran compounds was irritating after 6 hours contact. After 24 hours one subject showed hyperemia of the skin due to the presence of the furylacrylate. After 48 hours, 6 individuals out of 9 gave evidence of irritation due to this same compound,

while 3 out of 9 persons were affected by the ketone. None of the reactions were more severe than a moderate hyperemia. Apparently, these two compounds possess irritating properties for two-thirds and one-third, respectively, of the individuals tested at the concentrations used in the experiment. The other three compounds gave no evidence of irritation in any of the subjects in the concentrations tested.

## EFFECT OF FIVE NITROFURAN COMPOUNDS ON THE HEALING RATE OF EXPERIMENTAL WOUNDS IN RABBITS

For this experiment the 5 nitrofuran compounds here mentioned were incorporated into the washable base in three different concentrations. The ketone, furylacrylate, semicarbazone and furoate were made up in concentrations of 1:500, 1:1000, and 1:5000 in the base, while the propionate was compounded at 1:100, 1:500, and 1:1000. These concentrations were selected rather arbitrarily, al-

TABLE II.—HEALING TIME IN DAYS OF WOUNDS TREATED WITH 5-NITRO 2-FURYL-METHYL KETONE

Concentration	Average healing time for wounds on ventral surface	Average healing time for wounds on dorsal surface	Average healing time for all wounds	Shortest healing time for any wound	Longest healing time for any wound
1:500	21	17	19	12	28
1:1000	20	16	18	12	26
1:5000	17	17	17	10	22
Base	15	17	16	10	20
Untreated	12	14	14	10	16

though all of them are many times the minimum bactericidal concentration for these compounds as determined by *in vitro* methods. The fact that the previous experiment had shown the 1:500 concentrations of the ketone and furylacrylate to be irritating suggested that these concentrations would also interfere with the healing process, thus providing some information on the maximum concentration permissible for wound treatment. The following data, however, do not support this expectation since these concentrations show very little effect on the healing process, though they may not be optimal for use on healing wounds.

Twenty rabbits were used in the experiment and 5 to 8 wounds were inflicted on each rabbit. After removal of the hair from either the dorsal or ventral surface of the rabbits, the wounds were made with a rongeur and scalpel. The technique employed produced wounds quite similar in size and of equal depth. The wounds averaged 175 square millimeters in area and extended down to the muscle. The wounds on the ventral surface were observed to stretch more and become larger than those on the dorsal surface, which was attributed to the thinness and lack of connective tissue in the former as compared to the skin on the back.

The three concentrations of each compound in the base were applied to these wounds, and the effect on the healing rate was compared with untreated wounds and wounds treated with the base alone. The test substances were reapplied every 2 days, and sufficient material was applied to cover the wounds completely. The wounds were protected by small gauze and adhesive bandages ("Band Aid") and removal was prevented by cloth jackets tied around the rabbits. Their progress in healing was followed by the method of Carrel and Hartmann. Before each treatment tracings of the wounds were made on cellophane. These were transferred to plain white paper for measurement with a compensating polar planimeter. The process of healing was thus measured and recorded until complete healing occurred, which for these experiments was defined as the time when the new epithelium over the wound became continuous.

Fourteen days after the wounds were made biopsies obtained from those treated with each of the concentrations of the five compounds as well as from the control wounds were subjected to histological examination for evidence of possible irritation or injury due to nitrofurans compounds and as a further comparison of healing rates.

The results of this experiment can best be considered by presentation of the data obtained on

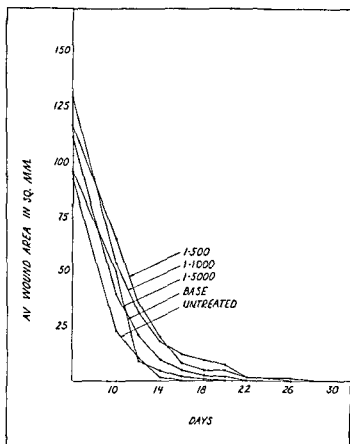


Fig. 1. Healing rates of wounds treated with 5-nitro-2-furyl methyl ketone, 1:500, 1:1000, and 1:5000 in a washable base. The inhibitory action of the three concentrations of the compound on epithelization is apparent after the 16th day.

each compound in order. A total of 130 wounds were observed, each compound being used on 18 wounds, 6 on each of the 3 concentrations employed. The tables and graphs which follow are based on the data obtained from 3 to 6 rabbits. Two control wounds were used on each animal, one untreated and one to which the base alone was applied.

The effect of 5-nitro-2-furyl methyl ketone on the healing rate of wounds in rabbits is demonstrated in Table II and Figure 1. A comparison of columns 2 and 3 in Table II shows that the variation in healing time between wounds on the dorsal and ventral surfaces of the animals was not significant. Column 4 demonstrates that the average healing rate was inhibited by this compound, the degree of inhibition increasing with the concentration. Columns 5 and 6 show that the process of wound repair progressed at a very different rate from animal to animal, emphasizing both the individual differences between animals and the value of controls on each.

Since the decrease in the area of the wounds between successive measurements varied directly with the rate of healing, the average areas of the





Fig. 2, left. Rabbit 1 on the 10th day of treatment with 5-nitro-2-furyl methyl ketone (N.P. No. 135). Wounds. Upper left, 1:500. Upper right, 1:1000. Middle left, 1:5000. Middle right, base alone. Lower left, untreated.

Fig. 3. Rabbit 2 on the 10th day of treatment with 5-nitro-2-furyl methyl ketone (N.P. No. 135). Wounds. Upper left, 1:500. Upper right, 1:1000. Middle left, 1:5000. Middle right, base alone. Lower left, untreated.

wounds were plotted against time for a graphic presentation of the effect of the various concentrations of the ketone on the healing rate. Experience had shown any significant variation in the process of wound repair to occur in the second half of the total healing period, hence the initial wound areas presented in all the graphs included here are those obtained on the sixth day of treatment.

Figure 1 shows the marked similarity in the rate of healing of all wounds used in the study of 5-nitro-2-furyl methyl ketone, but also demonstrates the inhibitory effect produced by this compound on the rate at which final epithelization of the treated wounds occurred. The initial sizes of the wounds were similar, and the healing rate curves all have essentially the same slope until about the sixteenth day. From this point on, during the time when the process of epithelization was observed to be the major repair process, the

inhibition of healing produced by the compound is apparent. It should be recalled that this compound was irritant to intact human skin at a concentration of 1:500.

The gross appearance of the wounds treated with 5-nitro-2-furyl methyl ketone and with the base alone was essentially the same as the untreated wounds (Figs. 2, 3) except that the latter did not develop as heavy a crust as the treated wounds.

Table III presents the observations made on the healing time of wounds treated with ethyl 8-(5-nitro-2-furyl) acrylate. In this group of animals the wounds on the dorsal surface healed more rapidly than did those on the ventral surface. Columns 5 and 6 again emphasize the individual differences in animals, showing that the slowest healing wounds required more than twice as much time as the fastest. The data in column 4 indicate that the test compound had no appreciable effect on healing when present at a concentration of 1:5000, but did produce a slight extension of healing time at 1:1000 and 1:500.

Figure 4 graphically demonstrates the inhibitory effect of the higher concentrations of ethyl 8-(5-nitro-2-furyl) acrylate on the healing of wounds as compared to controls treated with the base alone and to untreated controls. This effect appears to be similar to that produced by the previously described compound in that it occurs late in the process of healing, at the time of final epithelization, although the effect in this instance is not as marked. Grossly all wounds appeared similar (Figs. 5 and 6).

The data in column 4, Table IV, show that the third test compound, 5-nitro-2-furfuryl propionate definitely slowed the healing process in all three concentrations employed, although this effect was no more marked at 1:100 than it was at a 1:1000 concentration. Columns 2 and 3 again show that wounds on the back healed a little sooner, and columns 5 and 6 emphasize the previous data pointing to the wide variability in the healing rate of wounds on individual animals.

TABLE III.—HEALING TIME IN DAYS OF WOUNDS TREATED WITH ETHYL 8-(5-NITRO-2-FURYL) ACRYLATE

Concentration	Average healing time for wounds on ventral surface	Average healing time for wounds on dorsal surface	Average healing time for all wounds	Shortest healing time for any wound	Longest healing time for any wound
1:500	19	16	17.5	12	26
1:1000	20	13	16.5	10	18
1:5000	16	14	15	10	24
Base	16	14	15	10	22
Untreated	15	11	13	10	22

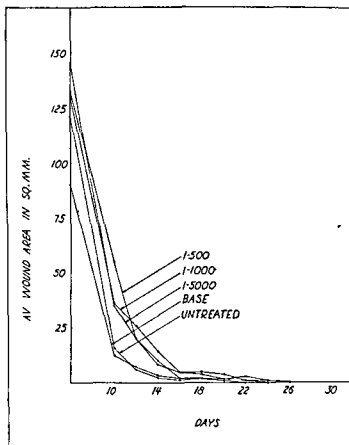


Fig. 4. Healing rates of wounds treated with ethyl  $\beta$ -(5-nitro-2-furyl) acrylate, 1:500, 1:1000, and 1:5000 in a washable base. The higher concentrations prolong the healing time of wounds as compared to the control wounds. This effect is most apparent in the period after the sixteenth day.

Figure 7 illustrates the slight prolongation of healing time produced by all three concentrations of this compound as compared to the control wounds. The gross appearance of the treated wounds as shown in Figures 8 and 9 was not significantly different from those receiving no treatment.

The results of the treatment of wounds with *n*-propyl-5-nitro-2-furoate are presented in Table V. The figures in column 4 indicate that this compound had no significant effect on the healing

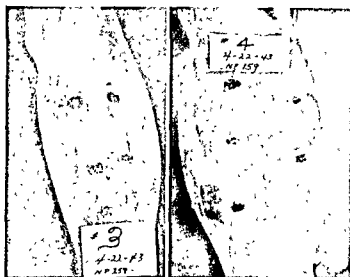


Fig. 5, left. Rabbit No. 3 on the 10th day of treatment with ethyl  $\beta$ -(5-nitro-2-furyl) acrylate (N.P. No. 159). Upper left, 1:500. Upper right, 1:1000. Middle left, 1:5000. Middle right, base alone. Lower left, untreated.

Fig. 6. Rabbit No. 4 on 10th day of treatment with ethyl  $\beta$ -(5-nitro-2-furyl) acrylate (N.P. No. 159). Upper left, 1:500. Upper right, 1:1000. Middle left, 1:5000. Middle right, base alone. Lower left, untreated.

process as noted with the previous compounds. The apparently anomalous result of 17.5 days average for the healing of wounds treated with a concentration of 1:1000 must be discounted as perhaps due to some unrecognized error, since wounds treated with both the larger and smaller concentrations healed, on the average, in a period of time equal to that of the untreated controls and somewhat sooner than that of those treated with the base alone. The previously noted tendency of wounds on the back to heal more quickly than on the ventral surface is again apparent in this group of animals as listed in columns 2 and 3. Again, the variability in the healing of wounds on individual animals is emphasized by the shortest and longest healing time observed for any wound given in columns 5 and 6.

Figure 10 illustrates the similarity of all wounds in this group both treated and untreated, empha-

TABLE IV.—HEALING TIME IN DAYS OF WOUNDS TREATED WITH 5-NITRO-2-FURFURYL PROPIONATE

Concentration	Average healing time for wounds on ventral surface	Average healing time for wounds on dorsal surface	Average healing time for all wounds	Shortest healing time for any wound	Longest healing time for any wound
1:200	18	16	17	12	24
1:500	17	16	16.5	10	24
1:1000	18	16	17	12	24
Base	15	13	14	10	20
Untreated	14	12	11	12	16

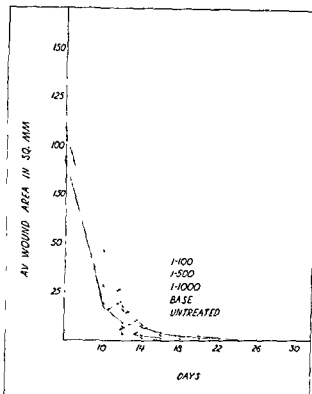


Fig. 7. Healing rates of wounds treated with 5-nitro-2-furfuryl propionate, 1:100, 1:500 and 1:1000 in a washable base. All three concentrations slowed the rate of treated wounds as compared to wounds treated with the base alone or untreated wounds.

sizing the lack of any inhibitory action due to the presence of this compound (see also Figs. 11 and 12). Even the previously noted and unexplained results obtained with wounds treated with a concentration of 1:1000, do not produce a markedly dissimilar healing rate or modify the gross appearance of all the wounds in this group.

The results in Table VI are from wounds treated with 5-nitro-2-furfuraldehyde semicarbazone. Column 4 shows that this compound is like the previous one in that none of the three concentrations tested had any inhibitory effect on the rate of healing as compared to either wounds

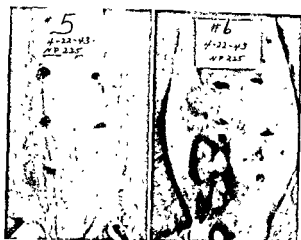


Fig. 8, left. Rabbit No. 5 on the 10th day of treatment with 5-nitro-2-furfuryl propionate (N.P. No. 225), 1:100, 1:500 and 1:1000 in a washable base. Wounds. Upper left, 1:100. Upper right, 1:500. Middle left, 1:1000. Middle right, base alone. Lower left, untreated.

Fig. 9. Rabbit No. 6 on the 10th day of treatment with 5-nitro-2-furfuryl propionate (N.P. No. 225), 1:100, 1:500, and 1:1000 in a washable base. Wounds. Upper left, 1:100. Upper right, 1:500. Middle left, 1:1000. Middle right, base alone. Lower left, untreated.

treated with the base alone or untreated wounds. In fact, wounds treated with a concentration of 1:1000 of this compound showed an average healing time shorter than the controls. Figure 13 emphasizes the similarity of the healing process of all wounds in this group of animals, and Figures 14 and 15 show the wounds on two of these rabbits on the tenth day of treatment.

In summary, it can be noted that three of the nitrofurans compounds tested, 5-nitro-2-furyl methyl ketone, ethyl  $\beta$ -(5-nitro-2-furyl) acrylate and 5-nitro-2-furfuryl propionate caused a slight prolongation of the healing time of wounds in rabbits, while no such effect was observed in wounds treated with either *n*-propyl-5-nitro-2-furoate or 5-nitro-2-furfuraldehyde semicarbazone. No other effect was noted with any of the compounds. A review of the tabulated general average healing periods for wounds treated with the

TABLE V—HEALING TIME IN DAYS OF WOUNDS TREATED WITH N-PROPYL-5-NITRO-2-FUROATE

Concentration	Average healing time for wounds on ventral surface	Average healing time for wounds on dorsal surface	Average healing time for all wounds	Shortest healing time for any wound	Longest healing time for any wound
1:500	16	14	15	12	20
1:1000	19	16	17.5	10	16
1:5000	14	16	15	10	20
Base	18	16	17	12	22
Untreated	16	14	15	10	22

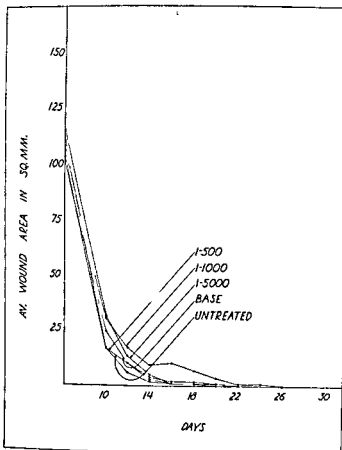


Fig. 10. Healing rates of wounds treated with n-propyl-5-nitro-2-furoate, 1:500, 1:1000 and 1:5000 in a washable base. This compound did not significantly affect the healing time of treated wounds as compared with the controls.

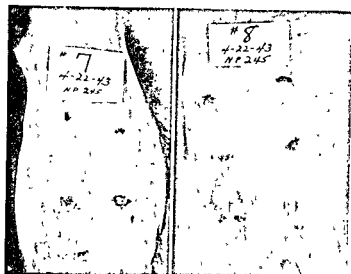


Fig. 11, left. Rabbit No. 7 on the 10th day of treatment with n-propyl-5-nitro-2-furoate, (N.P. No. 245), 1:500, 1:1000, and 1:5000 in a washable base. Wounds. Upper left, 1:500. Upper right, 1:1000. Middle left, 1:5000. Middle right, base alone. Lower left, untreated.

Fig. 12. Rabbit No. 8 on the 10th day of treatment with n-propyl-5-nitro-2-furoate, (N.P. No. 245), 1:500, 1:1000, and 1:5000 in a washable base. Wounds. Upper left, 1:500. Upper right, 1:1000. Middle left, 1:5000. Middle right, base alone. Lower left, untreated.

2.5 per cent, neutral acriflavine 2.5 per cent, and gentian violet in water) extended healing time of burns in rabbits, 5 and 40 days respectively.

A histological examination of tissue taken from both treated and untreated wounds on animals in all test groups on the fourteenth day of treatment was done. The results corroborated the above observations that the only effect produced by the compounds was a slight inhibition of healing by the three named above. This examination failed to emphasize even this effect since little or no difference could be found between treated and untreated tissue regardless of the compound used.

#### TOXICITY OF NITROFURAN COMPOUNDS BY ABSORPTION FROM LARGE WOUNDS

The following experiment was designed to determine possible toxicity of the nitrofurans com-

TABLE VI.—HEALING TIME IN DAYS OF WOUNDS TREATED WITH 5-NITRO-2-FURALDEHYDE SEMICARBAZONE

Concentration	Average healing time for wounds on ventral surface	Average healing time for wounds on dorsal surface	Average healing time for all wounds	Shortest healing time for any wound	Longest healing time for any wound
1:500	16	12	14	10	20
1:1000	20	13	11.5	10	14
1:5000	14	12	13	10	16
Base	14	13	13.5	10	16
Untreated	15	11	14	12	16

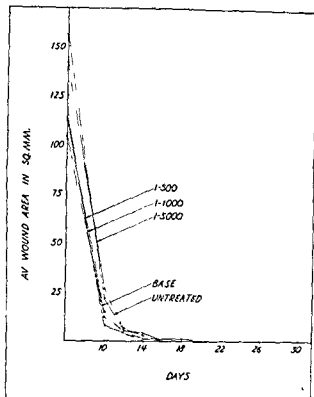


Fig. 13. Healing rates of wounds treated with 5-nitro-2-furaldehyde semicarbazone, 1 500, 1 1000, and 1 5000 in a washable base. No inhibitory effect on the healing rate was observed in wounds on which this compound was employed. The wounds treated with a 1 1000 concentration healed even faster than the controls.

pounds discussed in the work described by continuous absorption from large wounds when the compounds were present over a prolonged period. The conditions are thus similar to the clinical use of local antiseptics on large wounds. Toxicity under such conditions depends on, first, absorption of the compound, and second, its toxic properties.

An idea of this second factor for each of the five compounds tested can be gained from the data to be given on the L.D. 50 for mice and rats by the oral and subcutaneous routes of administration. It must be borne in mind, however, that these figures cannot be applied directly to rabbits on which the present work was done, but merely

Compound	L.D. 50—Mice orally mgm./kgm.	L.D. 50—Rats subcutaneously mgm./kgm.
5-nitro-2-furyl methyl ketone	400	200
5-nitro-2-furaldehyde semicarbazone	600-700	>3000
n-propyl-5-nitro-2-furoate	1200	>2000
5-nitro-2-furfuryl propionate	300	700
ethyl $\beta$ -(5-nitro-2-furyl) acrylate	3500	>4000

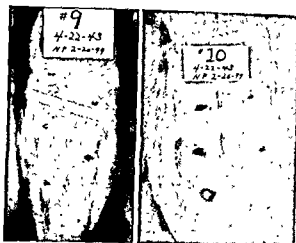


Fig. 14, left. Rabbit No. 9 on the 10th day of treatment with 5 nitro-2-furaldehyde semicarbazone, (N.P. No 2-20-90), 1 500, 1 1000, and 1 5000 in a washable base. Upper left, 1 500. Upper right, 1 1000. Middle left, 1 5000. Middle right, base alone. Lower left, untreated.

Fig. 15. Rabbit No. 10 on the 10th day of treatment with 5 nitro-2-furaldehyde semicarbazone, (N.P. No 2-20-90), 1 500, 1 1000, and 1 5000 in a washable base. Upper left, 1 500. Upper right, 1 1000. Middle left, 1 5000. Middle right, base alone. Lower left, untreated.

serve to indicate the toxicity found under controlled methods of administration.

Because of the lack of a chemical test to determine the presence of the compounds in the blood, the dosage applied to the wounds in this experiment was large, with the hope that toxic symptoms might be produced which could be detected by either gross or microscopic methods, thus indicating the occurrence or lack of absorption. Accordingly, the animals were exposed to approximately 250 milligrams per kilogram of each compound continuously for a month as indicated. This dosage is obviously much lower in many cases than that given, but the fact of the continuous presence of the compounds made the conditions rather severe.

The method of application consisted of the preparation of large wounds with areas of approximately 25 to 50 square centimeters on the ventral surface of the rabbits to which the compounds were continuously applied for a period of 4 weeks. The appropriate dose of the substance was concentrated in approximately 2 grams of the washable base previously described and applied to a square piece of gauze which was placed over the wounds and held in place with adhesive tape. A cloth jacket was then tied in place over all to protect the dressings. The compounds were applied immediately after the wounds were made and at weekly intervals afterward. This ensured an excess of material in contact with the wounds

at all times. Weight records, blood examinations and blood urea nitrogen determinations were done before and after the treatment period. Urine analyses were useless because of the tendency of many apparently normal rabbits to albuminuria. At the termination of the experiment, all animals were sacrificed and the tissues were studied microscopically.

5-Nitro-2-furyl methyl ketone was the only one of the five compounds tested to produce death or symptoms of toxemia. The 2 rabbits treated with this compound as outlined died in 24 to 48 hours. Four more rabbits treated by the same method but with a dosage of 100 to 200 milligrams per kilogram also died in 1 to 2 days. However, 50 and 65 milligrams per kilogram were applied, as has been described, for a full month without any symptoms of toxemia, nor did the histological examination reveal any abnormalities present in any of the tissues.

The other four compounds were used at the stated dose on two rabbits each for the full experimental period of 4 weeks without any symptoms of toxemia appearing. None of the rabbits showed a significant weight variation. The blood picture was essentially normal, the only possible significant finding being a slightly lower hemoglobin value. Blood urea nitrogen determinations were well within the limits determined on normal rabbits. The histological examination of the tissues of these animals was also entirely negative for any abnormalities attributable to the compounds.

Observations were made on the wounds during this period although because of the large concentration of compounds present no attempt was made to measure the effect on healing. However, no gross sign of irritation was observed. Heavy crusts or scabs formed over all wounds regardless of the compound applied. However, differences were observed. Ethyl  $\beta$ -(5-nitro-2-furyl) acrylate, *n*-propyl-5-nitro furoate and 5-nitro-2-furaldehydes emicarbazone caused a considerable quantity of tough, elastic necrotic tissue to be formed in wounds on which these compounds were present. Less of this material was noted in wounds treated with 5-nitro-2-furyl methyl ketone and none was found when 5-nitro-2-furfuryl propionate was used.

As a result of this experiment it can be concluded that four of the five compounds discussed here are nontoxic for rabbits when applied to large open wounds in doses of approximately 250 milligrams per kilogram of body weight continuously for 4 weeks. One compound, 5-nitro-2-furyl methyl ketone, is toxic under similar conditions,

causing the death of rabbits in 1 to 2 days. However, no toxicity was encountered when the quantity of chemical applied was reduced to 50 to 65 milligrams per kilogram.

#### COMMENT

Previous work has established the antibacterial action of the five nitrofur compounds discussed here, which suggested an investigation of their possible use in the local treatment of infected wounds. Compounds intended for such a purpose should also be nonirritating to human skin, nontoxic on local application to large denuded areas for long periods of time; produce no adverse effect on healing, and the antibacterial activity should not be abolished by organic matter.

The present work has demonstrated that two of the five compounds studied, *n*-propyl-5-nitro-2-furoate and 5-nitro-2-furaldehyde semicarbazone qualify as efficient antibacterial substances which are nonirritating and nontoxic under conditions of local application and do not delay the healing process in wounds in rabbits. In addition, Neter has shown that 5-nitro-2-furaldehyde semicarbazone was effective in the treatment of wounds in rabbits infected with hemolytic streptococci.

As a result of these studies, 5-nitro-2-furaldehyde semicarbazone (designated as furacin) was deemed worthy of clinical trial. It was incorporated 1:500 in the washable base which was previously described for use on infected wounds in humans.

At the time of this writing, Snyder, Kiehn and Christophersen have prepared a preliminary report on a small series of cases of infected wounds treated with this preparation in which favorable clinical and bacteriological results were obtained and have recommended its further trial. They have also noted the lack of toxicity, irritation, and interference with healing which has been described in the present work on rabbits. Several other clinical trials are being conducted by McCollough and by Shipley who corroborate the earlier findings of Snyder and his associates.

Certain justifiable criticisms have been made recently of the experimental method used in this work as a valuable measurement of the healing rate of wounds. It has been pointed out by several workers that the method records chiefly the rate of contraction of the wounds and that it is not an accurate measurement of the rate of epithelization.

No attempt is made here to refute these criticisms, since the aim of this investigation was to provide as much information as possible with the

methods available on the properties of these compounds under conditions of continuous local application.

It is interesting to note, therefore, that the findings recorded here by the method of Carrel and Hartmann on the failure of 5-nitro-2-furaldehyde semicarbazone to interfere with healing were substantiated by the histological findings. It has also been shown by those investigating the clinical utility of this compound that epithelial grafts covered with it have consistently given excellent results and that no interference with the rate of epithelization was indicated.

#### SUMMARY

Five nitrofurantoin compounds of previously proved antibacterial activity were tested for irritation to human skin and for toxicity and effect on healing when applied to wounds in rabbits. Two compounds, *n*-propyl-5-nitro-2-furoate and 5-nitro-2-furaldehyde semicarbazone were found to be nonirritating, nontoxic, and have no adverse effect on healing under the conditions of the experiments. Because of its superior antibacterial activity, 5-nitro-2-furaldehyde semicarbazone has been recommended for clinical trial in infected wounds and preliminary trials show favorable clinical and bacteriological results.

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# MALIGNANT LESIONS OF THE DUODENUM

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**K**NOWLEDGE gained in the performance of pancreatectomy and in the post-operative care of the patients is applicable to the surgery of malignant lesions of the duodenum and papilla of Vater. The circumvention of the difficulties involved in the partial removal of the pancreas and duodenum with provision for the re-establishment of biliary and alimentary continuity is the same for all three lesions.

## PATHOGENESIS

The rarity of carcinoma of the small intestine has provoked extensive discussion (13). Like the fallopian tubes and the spleen, the small intestine is so infrequently the site of a primary malignant lesion that it prompts search for some factor causing refractoriness to malignant change. If some of the hypotheses of the causation of cancer are correct, duodenal malignant lesions should be common. Let us take trauma as an example. The horizontal or third portion of the duodenum lies over the third lumbar vertebra and therefore is exposed to trauma. The duodenojejunal flexure, where fixed intestine becomes free, is a frequent site of duodenal rupture. Looking for sites where chronic irritation is common, one finds that the duodenum is a retort that is constantly charged with acids, alkalis, enzymes, bile salts, cholesterol, and the things we eat and drink. Chronic duodenal ulcers and erosion around duodenal fistulas are evidence of irritative properties of the duodenal contents.

Advocates of the hypothesis of malignant degeneration in gastric ulcers must assume some inhibitory influence in the duodenum. In 3 of the cases studied in this paper the pathologist seemed to concur with Jefferson's opinion (15), drawn from 30 collected cases, that carcinoma of the duodenum may result from malignant degeneration in an ulcer (4). But it may be pointed out that carcinoma of the duodenum does not show the predilection for the first inch of the duodenum that characterizes duodenal ulcer, even though, like duodenal ulcer, it is more common among men than among women. Critical examination of Jefferson's case reveals that the lesion may have

been a carcinoma from the very first. He assumed that, because the lesion was diagnosed as a benign ulcer by palpation and 2½ years elapsed before the carcinoma was obvious, the lesion was originally benign. Examination of our cases shows that the patient may live for many years after gastroenterostomy for duodenal carcinoma. Even if every carcinoma in the first part of the duodenum resulted from a duodenal ulcer, the incidence of duodenal carcinoma is so small as compared with that of duodenal ulcer that only an infinitesimal percentage of duodenal ulcers would undergo malignant degeneration.

Duodenal mucosa makes contact with gastric mucosa, two pancreatic ducts and one biliary duct. The cells of Brunner's glands perforate the muscularis mucosae. Robertson has reviewed the difficulties that confound the diagnosis of carcinoma of the duodenum. He observed that Brunner's glands are extremely passive and do not undergo any special or prominent alterations under abnormal conditions. Brunner's glands are most abundant in the first few inches of the duodenum and in the tissue surrounding the papilla of Vater. Review of the literature on the few cases in which malignant changes have occurred in the cells of Brunner's glands reveals that paradoxically the only carcinomas arising unquestionably from the cells of Brunner's glands are questionable carcinomas. Robertson presented data on one case in which there was unorganized hyperplasia with cells showing hyperchromatism, irregular arrangement and occasional mitotic figures. Since then we have encountered a surgical case in which proliferative changes in the cells of Brunner's glands were great enough to suggest to some of the pathologists examining the lesion that it was a definite carcinoma (Fig. 1). This case is not included in this series because its status is open to question.

Then there is the possibility of malignant degeneration in heterotopic tissues (9). In 23.5 per cent of cases of aberrant pancreatic islands, the aberrant tissue occurred in the duodenum (6). Diverticula may contain ectopic pancreatic or gastric mucosa (8,27). In this respect it is interesting to note that in 3 of the cases in this series diverticula were present and in 1 case an aberrant pancreatic nodule was found. Polyps, adenomas,

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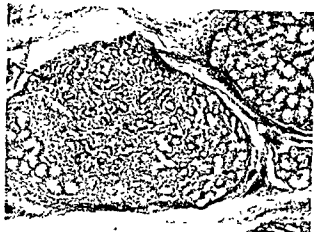


Fig. 1. Very low grade carcinoma of the duodenum in which the cells seem to have originated from the cells of Brunner's glands.

and papillomas may also undergo malignant change. It is surprising that carcinoma of the duodenum is not more common than it is. From our study we concluded that carcinoma of the duodenum may originate from any of the cells mentioned, but the bulk of the lesions represent anaplastic changes in the duodenal mucosa itself. If any of the processes mentioned contributed a considerable number of the lesions, this would be reflected by an increased incidence at the site of predilection of that process. In our series after exclusion of cases of carcinoma of the papilla of Vater the lesions were quite evenly distributed throughout the duodenum. Those who dismiss as imaginary the possibility of malignant change ever occurring in certain benign lesions of the duodenum must assume some extraordinary resistance conferred on the tissue by their presence (2).

The duodenum is rarely the site of metastatic lesions from other organs. Of course, as it progresses, carcinoma from the pancreas, because of its proximity, may perforate through the duodenum. No tissue will stop in very case the invasive growth of contiguous carcinoma. It is said that carcinoma of the stomach will stop short at the pylorus and carcinoma of the cecum will stop at the ileocecal valve but exceptions are encountered from time to time. Furthermore, such a lesion may stop abruptly at its contact with the small intestine and yet invade a loop of ileum or jejunum from without a short distance away.

Lieber, Stewart and Lund (17), Stewart and Lieber (26), and Berger and Koppelman have presented excellent reviews of reported cases of carcinoma of the duodenum. Bringing their figures up to date and including the cases presented here that have not been reported pre-

viously, one may state that 718 cases have been reported, of which 433 are acceptable. Considering that many cases are unreported, it is apparent that the lesion is not as rare as textbooks state it to be. Roughly, it occurs about 33 times in 100,000 necropsies (based on Eger's 350,286 collected necropsies) as compared with 3,000 times for carcinoma of the stomach. It comprises 0.3 per cent of intestinal carcinomas (12).

Because the cases in the literature are derived predominantly from postmortem material, we have avoided an elaborate analysis of the symptoms, which are usually terminal, representing the invasion of contiguous structures. This fact was demonstrated in several of the cases studied here, in which histories of the same patient taken a year or more apart by independent observers revealed how readily a patient forgets early symptoms when more distressing symptoms overshadow them.

#### MATERIAL FOR STUDY

There are 45 cases of surgical and 4 of non-surgical malignant lesions of the duodenum in the records of the Mayo Clinic (15 of these cases have already been reported—11,16,20,24). In 13 cases the lesion was verified at necropsy. This study does not include carcinoma of the ampulla or papilla of Vater, which entails the possibility of lesions arising from the common bile duct, the ducts of Wirsung and Santorini, the ampulla or the papilla. Cases in which the pancreas was involved were omitted from this study unless the study of the edge of a slowly growing lesion revealed that it was of duodenal origin. Probably some cases of duodenal carcinoma are classified as pancreatic or vaterian, since at the time of examination the lesion has extended so far in some cases that its primary location cannot be ascertained. However, such cases must be credited to the more common lesion; that is, pancreatic or vaterian carcinoma. A brief analysis of the proved cases is presented here to elucidate some of the points of interest to the surgeon.

#### PATHOLOGY

In 44 of the cases the lesion was carcinoma of the duodenum. In 2 it was sarcoma, in 2 leiomyosarcoma and in 1 lymphangioendothelioma, which showed involvement of the regional lymph nodes. In 2 of the cases there were simultaneous independent gastric carcinomas and in 1 there was a synchronous lesion of the jejunum. In 3 cases a duodenal ulcer was coexistent and in 1 there was aberrant pancreatic tissue. Polypoid lesions were twice as frequent as ulcerated lesions. There have



Fig 2. Sharply demarcated constricting deformity in the descending (second) portion of the duodenum, with obliteration of the folds of mucous membrane in the deformed part. These features identify the lesion as a neoplastic one.

been many attempts in the literature to attribute significance to the cylindric type of carcinoma or the spheroidal form, to hard scirrhous or soft medullary forms, but we found such distinctions of little value. As in carcinoma at other sites, the grade (Broders' method) of the lesion, the involvement of the lymph nodes and local or distant extension determined the prognosis.

#### INCIDENCE

*Age.* In the majority of the cases the patients were in the sixth or seventh decade. The average



Fig 3. Crescentic deformity in the horizontal (third) portion of the duodenum. The tumor was mostly intramural. The roentgenologic diagnosis was "leiomyoma."

age of the patients who had carcinoma was 55.4 years. The youngest patient who had carcinoma was 26 years of age, 1 was 39 years, 8 patients were in the fifth decade, 18 in the sixth, and 16 in the seventh. The age of both patients who had leiomyosarcoma was 38 years. The sarcomas occurred at 17 and 64 years and the lymphangi-endothelioma occurred at 27 years of age.

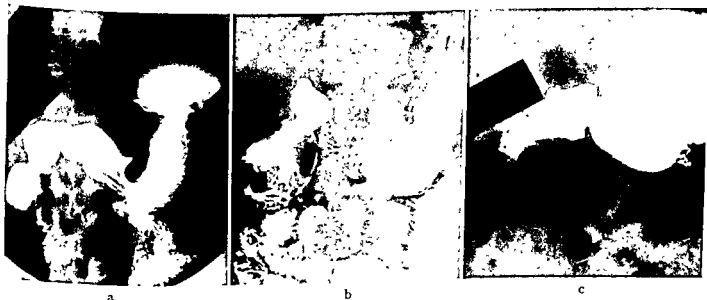


Fig 4. Lesions of neighboring organs causing deformity in the duodenum. a, Carcinoma of the head of the pancreas extending into and causing ulceration in the duodenum and displacing it downward and toward the right side. b, Carcinoma of the hepatic flexure of the colon extending

to and involving the duodenum. c, Lymphoblastoma of the retroperitoneal lymph nodes constricting a long portion of the duodenum without actually invading it. In all instances the extrinsic nature of the lesions was suspected at roentgenologic examination.

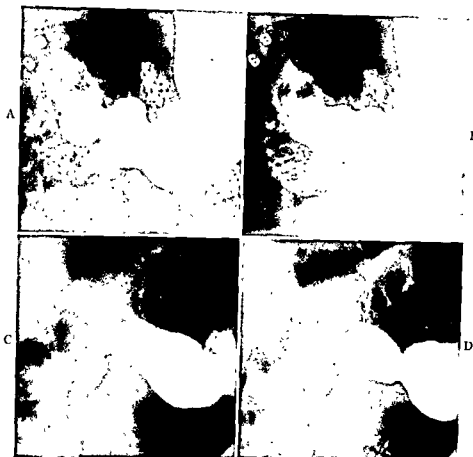


Fig. 5. a and b, Deformity of the first portion of the duodenum caused by primary carcinoma; the roentgenologic diagnosis was "duodenal ulcer" c and d, Deformity in the second (descending) portion of the duodenum caused by benign peptic ulcer, the roentgenologic diagnosis was "ulcerating lesion" but neoplasm was suspected.

**Sex.** Thirty of the patients who had carcinoma were men and 14 were women. The patients who had leiomyosarcoma were both men while the 2 patients who had sarcoma were women. The patient who had lymphangioendothelioma was a man.

**Distribution.** Fourteen of the lesions occurred in the first part of the duodenum, 15 in the second, and 20 in the third part. In collected series the greatest number is found in the second part. This is the result of the inclusion of Vaterian carcinomas by many authors.

#### DIAGNOSIS

Because of their rarity, as compared with duodenal ulcers complicated by obstruction or bleeding, malignant lesions of the duodenum may frequently go undiagnosed. Experience at the clinic since 1938 has demonstrated that if both the clinician and the roentgenologist are on the lookout for such lesions, roentgenologic examination

will be extended to include the entire duodenum and thus make a morphologic diagnosis possible. Many of the reviewers, following the lead of Pic, have devoted much effort to the differentiation by symptoms of lesions of the suprapapillary, peripapillary, and infrapapillary regions of the duodenum. They have gone into great detail, taking cases in which the lesion was discovered at necropsy, then going back and studying the record. We might say that one is doing well if one suspects the presence of a lesion of the pancreas, bile duct, or duodenum strongly enough to suggest that roentgenologic examination of the upper part of the gastrointestinal tract include the second and third portions of the duodenum. That is the way that definitive diagnoses were made in this series.

The symptoms of duodenal carcinoma are frequently present over a relatively long period. The average duration before admission was 11.8 months, with 2 patients giving a history of 6



Fig 6. Two examples in which carcinoma of the duodenum caused obstruction of relatively high degree. In a,

left, the roentgenologic diagnosis was "obstructing lesion"; in b, the roentgenologic diagnosis was "carcinoma."

years' duration. In the cases studied here the symptoms appeared to be a result of the morphologic characteristics of the lesion rather than of its position. Four processes within the lesion seemed to account for the symptoms regardless of whether it was in the first, second, or third part.

Obstruction by a napkin ring stenosis or by an intraluminal polypoid lesion was most common. The latter type seemed to produce more cramps and borborygmi than the former. With long-standing obstruction there is dilatation of the stomach and duodenum and observing patients may note the splash of the gastric contents produced by gastric retention. The vomitus will contain bile in lesions of the third part but be clear in lesions of the first part. However, pressure on the bile ducts by lymph nodes may alter this.

Second, the lesion may ulcerate or slough, producing bleeding. The first indication of the disease to some patients is weakness and fatigue produced by anemia. Some of the patients seen in the early history of the clinic had been treated by their physicians for pernicious anemia for many months, but blood smears soon showed that the anemia was a result of chronic loss of blood. It has frequently been suggested that there is some defect in the absorption of the intrinsic factor (23) in cases of duodenal carcinoma, but loss of blood was demonstrated in all cases in this series in which there was anemia. No cases in which there was macrocytic hypochromic anemia were encountered in this series. This is understandable when one observes that a relatively small portion

of the duodenum is involved by carcinoma. Meulengracht has suggested that the specific antianemic intrinsic factor is elaborated by the parts of the "pyloric gland organ," which is represented in the duodenum by Brunner's glands. In interpreting his hypothesis one should remember that hemopoiesis is not changed much after total duodenectomy and partial gastrectomy. The very low incidence of pernicious anemia after total gastrectomy is being studied now. Probably the critical test will come when total gastroduodenectomy is performed.

The third process that modifies the symptoms is perforation into the pancreas, in which case the pain of a pancreatic malignant lesion or pancreatitis may occur.

The fourth process that we wish to mention is obstruction of the biliary or pancreatic ducts. Carcinoma of the duodenum encroaching on the papilla of Vater will produce symptoms similar to those of vaterian or pancreatic carcinoma. One cannot assume from this that the lesion is in the second part of the duodenum, for involved nodes derived from a lesion of any part may cause jaundice, the first symptom, by pressure on the ducts. Occasionally there are points that aid in the differentiation. If the jaundice is preceded by signs of obstruction, one may suspect extension of a duodenal carcinoma. Intermittent jaundice favors the diagnosis of a duodenal lesion but a vaterian lesion may change its degree of obstruction by sloughing or reduction of inflammatory edema. Extrinsic involvement of a small segment of the common duct may produce obstructive



Fig. 7 Duodenum and part of jejunum and pancreas with the carcinoma of the duodenum.



Fig. 8. Photomicrograph of carcinoma of the duodenum (X125).

jaundice even though a probe can be passed through the lumen easily at operation. In this series there was no case in which there was enough hepatic involvement to produce jaundice. In fact, the few metastatic regions in the liver that were seen were small.

Pain in the epigastrium or right upper quadrant of the abdomen was the most common chief complaint. It was present in 38 cases. It frequently began 1 to 4 hours after meals and was relieved by vomiting or sodium bicarbonate but not by food or milk. The onset was sudden in 6 cases and pain came on at night in 7 cases. The pain was usually steady but in 10 cases it was cramplike. The absence of extension of the pain was so uniform that when extension did occur one could assume perforation into the pancreas or obstruction of one of the ducts. Twenty-seven of the patients complained of bloating and belching. Gastric retention was advanced enough to produce frequent vomiting in 16 cases. In many of these cases the patients discovered that they could avoid retention by taking a liquid diet. In 4 cases retention vomiting had produced frank tetany with the concentration of chlorides in the region of 300 milligrams per 100 cubic centimeters of plasma, that of urea at 125 milligrams per 100 cubic centimeters of blood, and carbon dioxide combining power more than 70 volumes per 100 cubic centimeters of plasma (19).

In 6 cases the only complaint was of progressive weakness and fatigue. These cases presented a diagnostic problem until examinations of blood and stool revealed a bleeding gastrointestinal lesion. The concentration of hemoglobin was less than 6 grams per 100 cubic centimeters of blood in 17 of the cases and more than

13 grams per 100 cubic centimeters of blood in 12 of the cases. Hematemesis was present in 9 cases and melena in 12 cases. No portion of the duodenum showed a greater predilection for bleeding or obstructive lesions than any other.

Jaundice was present in 8 cases. It was a late manifestation in all except the 1 case reported later. In half of the 8 cases of jaundice, the lesion existed in the second part of the duodenum. In 3 cases it was in the first part and in 1 it was in the third part. Thus one cannot conclude that the lesion is periampullar in cases of jaundice. In the 222 cases of periampullar carcinoma of the duodenum collected by Lieber, Stewart, and Lund (18), jaundice was present in all but 4 cases. In 41 per cent (26) of cases of carcinoma of the supra-ampullar region jaundice was present. This greater incidence of jaundice in the collected series than in our series results from the fact that in almost all of the cases the patient was in the terminal stages of his condition when he was observed. In a large proportion of the cases in this series in which palliative operation was performed, jaundice developed shortly before the patient's death.

Alteration of frequency of evacuation or of consistency of the stools is not a common symptom in cases of carcinoma of the duodenum. The presence of typical diarrhea would make one suspect obstruction of the pancreatic duct. This is found in 35 per cent of cases of Vaterian carcinoma (5).

Loss of appetite is not a common symptom among patients who have carcinoma of the duodenum. If one excludes the flatulence often present with gastric retention, only 2 of the patients complained of loss of appetite. One sees a

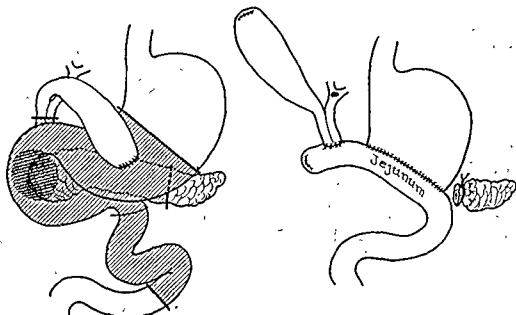


Fig. 9. Diagrams showing the situation of the lesion. The shaded area in the diagram on the left shows the extent of the region removed. The diagram on the right reveals the connections established between the biliary ducts and stomach and the jejunum.

similar situation among patients who have prolonged gastric retention after gastroenterostomy. They often complain of great hunger even when as much as 1,000 cubic centimeters of gastric contents is retained. In 16 of the 29 cases in which analysis of gastric contents was performed, anacidity was noted. The free acid content was high in 1 case, normal in 6, and low in 6. The average loss of weight in this series was 22 pounds (10.0 kgm.). The gall bladder was palpable in 2 cases. In 10 cases a mass was palpated in the upper part of the abdomen. In cases of carcinoma of the duodenum, the abdomen is usually flat and without gaseous distention.

#### ROENTGENOLOGIC DIAGNOSIS

Most reviewers state that a roentgenologic diagnosis of duodenal neoplasm is rarely made. Until relatively recent times this may have been true. However, that the roentgenologic diagnostic maneuvers, which have been used so successfully in the diagnosis of lesions in the esophagus, the stomach, the first portion of the duodenum and the large intestine, can be applied with almost equal success to the diagnosis of lesions of the small intestine is a fact that is becoming ever more widely appreciated. Weber and Kirklin reported on the experience at the Mayo Clinic with the roentgenologic diagnosis of neoplastic lesions encountered up to and including the year 1939. By then 17 instances of duodenal neoplasm had been encountered in which roentgenologic examinations of the duodenum were recorded.

The existence of a lesion and its site were correctly predicted in all but 2 of the cases, although the precise diagnosis of neoplasm was offered in only 9 of them.

Since 1939, 20 cases of duodenal neoplasm have been encountered. In every instance the existence of the lesion and its location were correctly predicted at the roentgenologic examination. In 12 of the cases the roentgenologic diagnosis of neoplasm was later established at pathologic examination of the tissue (Fig. 2). In a single case of leiomyosarcoma of the third portion of the duodenum the roentgenologic diagnosis was ulcerating leiomyoma (Fig. 3). In 7 cases the roentgenologic diagnosis was given in such expressions as "lesion," "filling defect," "polypoid lesion," "intrinsic lesion," and "crescentic defect." Although not ideally precise, terms such as these have a connotation of neoplasm and so are considered to be satisfactory; a roentgenologic diagnosis can hardly be expected to be more precise than a gross pathologic one.

Tumors and other lesions of structures in close anatomic proximity to the duodenum sometimes extend to it and involve it segmentally, producing a roentgenologic picture similar in many respects to that produced by primary duodenal neoplasms. Cysts and tumors of the pancreas are especially prone to do this but tumors of the common duct near the ampulla of Vater, of the hepatic flexure of the colon, and of the retroperitoneal lymph nodes (Fig. 4) have also been known to simulate the roentgenologic picture of primary duodenal

lesions very closely. Evidence of the essentially extraduodenal nature of such processes is usually elicitable at roentgenoscopic examination, for such lesions tend to be large, and careful palpation almost always gives the clue to the correct diagnosis.

Obstructed hollow viscera are notoriously difficult to work with roentgenologically and the higher the degree of obstruction, the more difficult it is to determine the precise pathologic nature of the obstructing process at roentgenologic examination. Obstructing lesions of the duodenum are not exceptions, especially when the obstruction is encountered at or just below the pyloric ring. In this situation the roentgenologic evidence for neoplasm must be well developed, indeed, if a diagnosis of neoplasm is to be entertained, for in all age groups benign duodenal ulcer is overwhelmingly more often the cause of obstruction at this level than are neoplastic processes (Fig. 5). On the other hand, nonneoplastic obstructing lesions, intrinsic in the duodenum, are encountered comparatively rarely in the second and third portions of the duodenum. Therefore, it is expedient to consider neoplasm as a diagnostic possibility whenever obstruction is roentgenologically demonstrated to exist at these levels (Fig. 6).

Obstruction of all degrees was observed in this series of cases, the amount of gastric contents retained varying from 200 to 1,400 cubic centimeters. Efforts at reducing the amount of gastric retention by repeated gastric lavage fail as a rule to facilitate satisfactory roentgenologic examination, no matter what the cause of retention may be or where this cause may be located. The roentgenologic examination is hindered as much by the presence of gastric secretion as it is by the gastric dilatation. It seems that the mere act of passing the stomach tube increases the flow of gastric secretion in most cases and days rather than hours are consumed in reducing the size of a stomach dilated as a result of chronic obstruction. For this reason, operation is usually recommended as soon as the fact of chronic obstruction is established, because in the great majority of instances surgical intervention will become necessary no matter what the cause of obstruction may prove to be.

The roentgenologic criteria for the diagnosis of neoplasm of the duodenum are identical with those used in the diagnosis of such lesions in other tubular portions of the gastrointestinal tract. They have been adequately described in other publications and we have no additional data along these lines to describe.

At this point we wish to repeat a warning about the administration of barium by mouth to patients presenting symptoms of intestinal obstruction. When the obstruction is high in the duodenum, the clinical picture is clear enough to make the procedure safe. But lesions near the duodenojejunal juncture may present a clinical picture in which a lesion of the lower part of the intestine must be considered. In such cases it is wise to proceed with caution and aspirate the stomach and duodenum. A lesion of the colon should be ruled out before proceeding with the standard roentgenologic examination of the small intestine. Serious consequences have often followed the injudicious administration of barium by mouth to a patient who had a lesion of the lower part of the intestine. In such cases partial obstruction may be converted to total obstruction by barium.

#### SURGICAL ASPECTS

Up to 1935, unless a segmental resection in the first or third part or local excision was possible, lesions of the duodenum were not considered removable. Experience with resection of the pancreas and duodenum has changed the attitude, and radical resections are now possible. While it may not be possible to remove the node-bearing tissue of the periaortic chain, local extension on the surface of the pancreas can be removed by partial pancreatectomy. Applicable operative procedures, designed primarily for the treatment of pancreatic and vaterian lesions, have been discussed repeatedly by Whipple, Brunschwig, and Hunt.

It is difficult to assign credit for the greater present-day success in radical pancreatoduodenectomy to any single advance in surgery. Relatively little is known of the physiology of the duodenum. Even the fundamental functions of its cells are not clearly established. But it appears that men and animals can get along without a duodenum (7). On the other hand, the physiology of the pancreas has been the subject of careful study for a century. Early removals of part or all of the pancreas were performed with some knowledge of the disturbances created. Improved knowledge of the control of the electrolytes of the blood, the use of vitamin K, the availability of bank blood and plasma, the preoperative and postoperative administration of vitamins, carbohydrates and proteins to bolster the liver, chemotherapy and antibiotics have each played its rôle, so that a procedure that was impossible for the masters of the previous generation is within the scope of the young surgeon of today.

There is great variation of the individual requirement for the external secretion of the pancreas. Results obtained in animals cannot be applied directly. The necessity of anastomosing the ducts of a partially removed pancreas to the jejunum remains to be evaluated. The various methods for re-establishing the flow of pancreatic juice add materially to the risk of the operation. While it is the opinion of many surgeons that the flow of pancreatic juice is important, if not essential, we have encountered cases in which the patient did well after total pancreatectomy or partial pancreatectomy with ligation of the stump. In fact, some of these patients did well even without the oral ingestion of pancreatin. Furthermore, we have no knowledge of how long the pancreatic external secretion effectively continues after such anastomosis. Answers to these and other problems will be found only after larger numbers of cases in which radical pancreatoduodenectomy has been performed are available for study. When it is necessary to remove the entire pancreas, replacement of insulin is not difficult but the requirement of lipocaic, choline, or other factors in prevention of hepatic damage and infiltration with fat after long periods of survival must be evaluated for human beings.

There are manifold technical problems which arise during the performance of radical pancreatoduodenectomy. Many of these are concerned with the method of handling the common duct. In cases of duodenal ulcer with cicatricial stenosis and in those of carcinoma of the pancreas, ampulla, or first or second part of the duodenum, along with shortening of the duodenum, there is often a shortening of the common duct. This tends to draw on the fork produced by the juncture of the cystic and hepatic ducts so that the angle is reduced and the two ducts are fused side by side. We have encountered several cases in which use of the gall bladder for anastomosis was contemplated but in which, after ligation of what was believed to be the common duct, the surgeon found that in reality he was clamping the cystic and common ducts. These two ducts may run side by side to a point close to the duodenum. Thus a previously made cholecystenteric stoma, while it relieves biliary obstruction, may have to be disconnected during pancreatoduodenectomy because it is in the way and because when the common duct is tied, unless a probe is passed, there is no way of being sure how far the bifurcation is from the ligature.

In the performance of a palliative anastomosis of the gall bladder to the intestinal tract there are many advantages to cholecystojejunostomy for

lesions in the region of the ampulla. If the gall bladder is anastomosed to the stomach and the patient survives for some time, the lesion may go on to obstruct the duodenum and the biliary flow will add to the vomitus. Hence it is better to anastomose the gall bladder to the jejunum than to the stomach. In 3 of the cases in this series, palliative cholecystenterostomy was followed by a subsequent palliative gastroenterostomy because the patient lived long enough to have duodenal obstruction.

*Preoperative measures.* So many vital functions are disturbed by lesions in the duodenum that extensive physiologic readjustments are necessary. Imbalance of electrolytes requires the intravenous or subcutaneous administration of sodium chloride and calcium. Anemia or hypoproteinemia makes blood transfusions essential. Determinations of prothrombin must be made to evaluate the need for vitamin K. Hepatic reserves must be bolstered by administration of carbohydrates and proteins. Intravenous administration of glucose is usually necessary to increase hepatic glycogen. Dilatation of the stomach must be reduced by repeated lavage.

During radical resections, which frequently involve more than 3 hours of operating time, intravenous administration of fluids is obligatory. In addition, the average patient requires at least 1,500 cubic centimeters of blood during and after the operation. Five to 8 grams of sulfathiazole should be dusted intraperitoneally. After radical resection it is usually wise to place the patient in an oxygen tent, administer blood, and maintain adequate blood levels of sulfadiazine and penicillin. Vitamin K should be added to the intravenously administered fluids, since biliary flow may be obstructed by edema.

#### REPORT OF A CASE

The following case illustrates some of the points stressed in this study.

The patient was a white woman 52 years of age. During the first week of January, 1943, she noted the sudden onset of a dull pain in the epigastrium "as if a lump was there." Belching and sour eructations were prominent. A week later she became jaundiced and pruritus was severe. Her appetite was good. It was believed that she had obstructive jaundice due to carcinoma of the pancreas. Severe hyperlipemia was present.

On February 3, 1943, cholecystogastrostomy was performed. The common duct and the gall bladder were dilated and a nodular mass was noted in the region of the pancreas. Biopsy of the liver revealed advanced infiltration with fat and cholangitis.

The patient was well for 1 year and then began to have severe epigastric pain, belching, and bloating. Her appetite was good but she lost 25 pounds (11.3 kgm.). At examination in January, 1945, there was no jaundice. The concen-



tration of hemoglobin was 8 grams per 100 cubic centimeters of blood and erythrocytes numbered 4,390,000 per cubic millimeter of blood. Analysis of gastric contents revealed an acidity. Roentgenologic examination of the stomach and duodenum revealed an obstructing lesion of the second portion of the duodenum with dilatation of the stomach and duodenum proximal to it.

On January 13, 1945, operation was performed. The entire duodenum, about 30 centimeters of jejunum and about two-thirds of the pancreas were removed. The cholecystogastric stoma was disconnected and choledochojejunostomy was performed. Half of the stomach was resected and gastroyejunostomy (posterior Pólya) was performed. During the procedure great difficulty was encountered in dissecting the pancreas free from the portal vein. Three small openings were made in the portal vein, and these were closed with fine silk. Figure 9 gives a rough diagrammatic approximation of the arrangement before and after operation. The shaded area depicts the region removed *en bloc*. The stump of the pancreas was closed by three catgut mattress sutures and left free in the peritoneal cavity. Passing from the patient's right to left the jejunum first received the biliary duct. The latter was represented by the biplicate cystic duct and hepatic duct, which looked like a single tube externally. Both were anastomosed end-to-side to the jejunum. The site of the previous anastomosis of the gall bladder to the stomach was sutured. The entire shortened common duct was found to have been removed with the specimen. The gastroyejunal stoma was made distal to the hepatoyejunal stoma and the jejunum was sutured to the mesocolon at the site of the former ligament of Treitz.

The tumor was an adenocarcinoma of the duodenum, grade 1 (Broders' method), without involvement of lymph nodes (Figs. 7 and 8). The postoperative course was uneventful. For a short time the patient was mildly diabetic with a fasting concentration of sugar of 145 milligrams per 100 cubic centimeters of blood. She required 15 tablets of pancreatin (Wilson) three times a day to give her one or two solid stools a day. There was slight drainage from the incision for 3 weeks. When she was examined 6 months later, her blood was normal. She had gained 7 pounds (3.2 kgm). There was no evidence of diabetes. She was well at the time when this paper was written—8 months after resection and 32 months after the lesion had been identified and considered inoperable at the first operation.

#### ANALYSIS OF OPERATIVE CASES

1. Combined duodenectomy, partial pancreatotomy, partial gastrectomy, partial choledochectomy and choledochojejunostomy was performed four times. There was 1 death in the hospital (25 per cent), which resulted from repeated gastric hemorrhages. The results in this group cannot be evaluated since the other 3 patients were alive when this paper was written 1 year, 7 months, and 3 months after operation.

2. Segmental duodenal resection with or without partial gastrectomy was performed four times with one death in the hospital (25 per cent). Here again the death was due to hemorrhage. Of the other patients, 1 died within 2 years while the remaining 2 were alive when this paper was written, 1 and 4 years after operation was performed.

3. Local excision was done in 1 case. The patient was alive 4 years after operation.

The remaining operations were palliative.

4. Posterior gastroenterostomy was performed twenty times with 4 deaths in the hospital (20 per cent). These patients were in very poor condition. In 2 instances the patients were unconscious as a result of gastric tetany and the operation was of an emergency nature. The surviving patients demonstrate that the lesion is frequently slow in progress when the obstruction is relieved. No doubt in some of the cases resection would have been performed if the patients had been seen recently. The average period of survival for this palliative procedure was 21 months, with 4 patients living 7, 6, 3, and 2½ years after the gastroenterostomy to account for the high figure.

5. Anterior gastroenterostomy was performed three times with no deaths in the hospital. One patient died in 1 year and another in 3 months. The third patient could not be located.

6. Duodenojejunostomy was performed three times with 1 death in the hospital (33 per cent). One patient died in 3 years and the other in 3 months.

7. Cholecystostomy was performed twice with 1 death in the hospital (50 per cent). The survivor died 7½ months after operation.

Thus there were 8 deaths in the hospital in 37 procedures—a mortality rate of 22 per cent.

8. Exploration only was done eight times with 4 deaths in the hospital (50 per cent). The average period of survival in the 4 cases was 5 6 months.

In reading the literature on carcinoma of the duodenum one gets the impression that the prognosis is very bad. However, most of the reported cases are taken from necropsy records. On the other hand, from the surgical cases presented here, one gets the impression that when radical duodenectomy is well established the results in cases of this rare lesion will be better. In the case presented earlier in this paper the lesion was resectable 2 years after it had been identified at a previous operation. While, in general, extension into the local nodes seems to occur relatively early, there is a long latent period before the lesion extends to distant sites such as the liver or lungs. The prognosis for lesions of the duodenum is better than for lesions of the jejunum or ileum. This may be explained by the proximity of the lesions of the duodenum to the stomach and the inclusion of two important ducts in the region, which tend to produce symptoms earlier. It is true despite the greater apparent ease of removal of lesions of the jejunum and ileum.

In the collected series in the literature it is stated that postoperatively the prognosis of lesions of the first and second parts of the duodenum is very poor. In this series 1 patient was alive when this paper was written, 6 years after resection of a lesion of the first part of the duodenum and another died 7 years after gastroenterostomy, at which time the lesion was confirmed by necropsy. In lesions of the third part of the duodenum the results are not as good, with only 2 patients alive 2 years after operation.

## SUMMARY

Forty-nine cases of malignant lesions of the duodenum, exclusive of lesions of the papilla of Vater, are analyzed. Obstructive features were prominent in 38 while in 6 cases anemia resulting from loss of blood was the chief finding. In 45 cases operation was performed. Radical resection was done in 4 cases, segmental resection in 4, and local excision in 1. The operative mortality rate in cases in which procedures other than exploration were performed (37 cases) was 22 per cent.

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gluteal fascia was first brought to my attention at the Mare Island Naval Hospital, in 1942, by Commander Charles E. Pope, then in charge of these cases. Miscall and Holder and F. C. Shute *et al.* have also described the use of the gluteal fascia but in a manner that entails approximation of these tissues under greater tension than the Pope procedure.

In the utilization of the gluteal fascia, certain details of management and technique have developed which are considered most important in achieving a successful primary closure:

1. As little trauma as possible is inflicted on all tissues. Even retractors are not used, so as to avoid injuring the delicate fat cells lining the wound.

2. Contrary to almost universal advice in recent articles, clamps on bleeding vessels are rigidly avoided! Patience and local digital pressure usually suffice to stop the bleeding, and rarely is it necessary to place any ligatures on bleeding arteries regardless of the forceful bleeding that follows the initial incisions, thereby reducing greatly the dead and traumatized tissue as well as the amount of foreign material left in the wound to interfere with healing. Our experiences with bleeding from divided arteries in this area substantiate the observation that a completely divided artery usually retracts into the tissues followed by cessation of bleeding. Frequently when bleeding persists, close inspection reveals that a tangential wound of an artery has been produced or a branch has been severed at a point flush with its emergence from the parent artery. An incision completely severing the artery at point of bleeding results in prompt cessation of bleeding.

Following excision *en bloc* of the diseased tissue the wound is packed lightly with gauze while the operator carefully explores the sinus tracts with a probe to determine if by chance any tract has been cut across leaving behind epithelial elements. If such oversight has occurred, wider excision is performed.

3. The interrupted sutures of No. 0 chromic catgut (Fig. 4A) approximating the fascia are minimal in number (4 to 8). The use of nonabsorbable sutures in this area was reluctantly abandoned after we had been compelled on a number of occasions to operate for the removal of buried sutures of cotton, silk, or wire placed there by others or by us. These sutures in the gluteal fascia serve also to bring together the overlying fat, so that no devitalizing and traumatizing sutures are applied in the subcutaneous fat. There are only two layers of suture: one approximating

the gluteal musculofascial flaps and one closing the skin (Fig. 4C).

4. The skin is approximated by a special continuous subcuticular stitch of dermol or wire applied 2 to 3 millimeter within the epithelial edge (Fig. 4B). The two ends of the dermol protrude from the wound at either end without any tying of knots. Frequently, the length of the incision requires that 2 such continuous sutures be applied (Fig. 5C) which are not withdrawn until the 7th or 8th day. The use of the subcuticular stitch which is considered a most important detail avoids passing sutures through infected skin into vulnerable fat. Skin sutures in this area, if left in place for several days, show redness and inflammation around each stitch hole, indicating that bacterial organisms are present which could easily penetrate the deeper tissues and infect the wound.

5. No drains should ever be used in this area, but the superior or posterior end of the wound is not closed for about 2.0 centimeters so as to provide an escape for tissue fluid or blood. At first the skin at the inferior or anterior end of the wound was incompletely closed but experience early taught us that the skin in the gluteal fold must be approximated very carefully—epithelial edge to epithelial edge—otherwise a small granulating wound remains in the gluteal cleft which heals poorly because of heat, moisture, and motion. As previously stated, this delayed and prolonged healing deep in the gluteal fold may produce a dimpling or downgrowth of epithelial elements below the level of surrounding skin—a factor which may favor the penetration of hairs into subcutaneous areas and the recurrence of infection. The wound is dressed with gauze moistened with tincture of merthiolate or zephiran solution so as to inhibit bacterial growth if later soaked with blood. To relieve tension from the sutures approximating the gluteal fascia, the two buttocks are securely strapped and pulled together with long adhesive strips. The wound is not dressed for 7 to 8 days. If bleeding occurs sufficiently for blood to escape the gauze dressings during the first 24 hours, the original dressing is not removed but is simply reinforced with additional gauze placed over it. An order to that effect is left with the nurse.

6. Chemotherapy is utilized *before, at, and after* operation. For 24 hours preceding the operation, penicillin is administered in optimum dosage (20,000 units intramuscularly every 3 hours), plus sulfadiazine and sodium bicarbonate, 1 gram each, every 4 hours orally; at intervals during the operation, sulfanilamide is smeared into all nooks, crannies, and crevices of the wound (3), and the

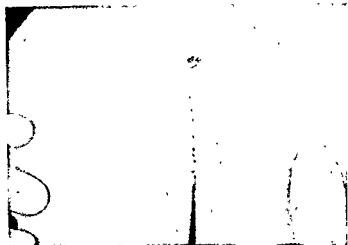


Fig. 1. a, Patient with subcutaneous abscess and eleven midline dimples. b, Nest of hairs completely surrounded by bone of the coccyx necessitating coccygectomy for complete removal of the pilonidal elements. Failure to recognize such deep penetration of hairs undoubtedly is responsible for some recurrences.



newly created raw surfaces are moistened with penicillin solution—(50,000 units in 25 c.c. water; the balance of 50,000 units is administered intravenously). After operation the administration of penicillin and sulfadiazine is continued as described for 4 or 5 days.

7. The patient is returned to his bed with specific instructions: He may lie on his abdomen or on his side and may stand to void, but he may not lie on his back nor may he sit. He is confined to bed except for lavatory privileges.

8. A nonresidual diet is imposed for 7 to 8 days, thus reducing the need of bowel movements to a minimum.

9. Even though healing is complete in 10 days to 2 weeks' time, military personnel are not returned to full duty under 4 to 6 weeks, in order not to jeopardize the final result in any way. An occasional sequel of the operation is a temporary numbness of the midline skin due to division or to temporary physiological block of subcutaneous nerve fibers incident to the mobilization of the gluteal fascia. This is usually not a subject for complaint, and gradually disappears.

When large subcutaneous abscesses have burrowed their way over the upper sacrum, the procedure described must be modified. The gluteal fascia is mobilized as here described to cover the coccygeal and lower sacral area. Over the upper sacral area where healing more readily occurs and where raw areas are not subjected to factors inhibiting healing as in the deep gluteal folds, the skin flaps are tacked down directly to the pre-sacral fascia (5) by interrupted sutures of fine catgut including a bite of the fascia and a bite of

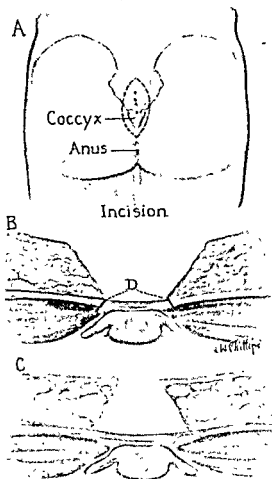


Fig. 2. A, Elliptical incision through skin and subcutaneous tissue. B and C, These incisions should be directed lateromedially and not mediolaterally to avoid undermining of skin and formation of an incollapsible dead space over coccyx and lower sacrum. D, Lines of incision in gluteal fascia which will permit its mobilization and approximation in midline.

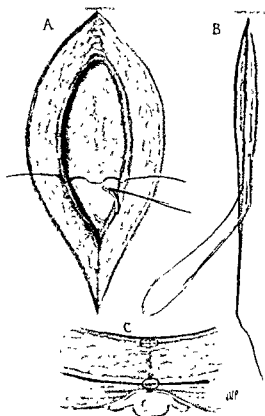
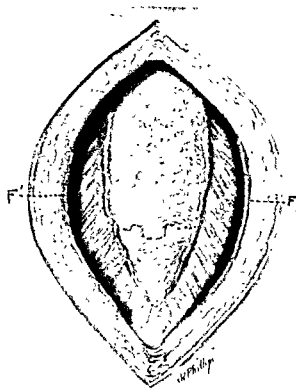


Fig. 3, left. Mobilization and lateral displacement of musculofascial flaps, *F* and *F'*, which will be united in midline overlying the coccyx and lower sacrum.

Fig. 4. A, Approximation of musculofascial flaps by four to eight interrupted chromic catgut No. 0, including also a bite in the midline of the precoccygeal or presacral fascia, thus insuring obliteration of the dreaded dead space. B, Approximation of skin is effected by continuous sub-

cutaneous tissue about 1.5 centimeters lateral to the skin edges. The skin edges may or may not be approximated by a subcuticular stitch of continuous dermol, leaving the superior 1.5 to 2.0 centimeters of the wound open. When the skin is not closed, there is usually only a small granulating area present as in the MacFee procedure which heals in a short time. Occasionally, the subcutaneous hair-containing abscess cavity extends anteriorly from the coccyx to a point lateral to the anus. After excision this lateral wound may be left either open or closed primarily.

When this method of closure fails, the wound is converted into an open one and treated as previously described for open wounds in this area. Despite failure of primary union it has been observed that the mobilization of the gluteal fascia permits more rapid cicatricial contracture of the

ticular sutures of dermol or steel which are not tied, and which after 8 to 10 days are completely withdrawn from the wound. The skin in the posterior 2 centimeters of the wound is not closed by sutures but is left open for the escape of blood and serum. C, Only two layers of sutures are necessary—one in the gluteal fascia which also approximates the fat, and a second layer in the subcutaneous tissue.

wound, and healing is not as prolonged as in the usual excision *en bloc* and open method of treatment.

As experiences with the method described have led to such modifications as the elimination of skin-penetrating sutures, the use of the subcuticular stitch, and the local and systemic administration of sulfonamides and penicillin, failures have definitely decreased. In the last 46 cases there have been 5 failures, 2 due to hematomas which required evacuation, resulting in delayed but not prolonged healing, and 3 due to infection, one with a pyocyanous infection that did not yield to penicillin and sulfa therapy, and one whose sinus involved the margin of the anus. It should be freely admitted that in the search for a dependable treatment of pilonidal cysts and sinuses, the methods used by many operators have been found successful some times, even

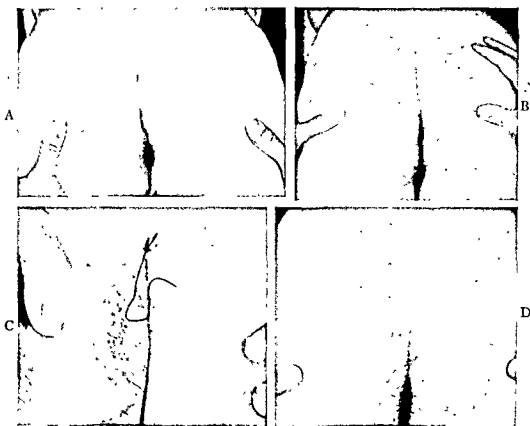


Fig. 5. a, Postoperative appearance in patient 1 on 10th day. b, Postoperative appearance in patient 2 on 12th day. c, Postoperative appearance in patient 3 on 7th day before removal of two dermol continuous sutures; the protruding suture is cut off at one end and pulled out of tissues by traction on other end. The dark area at posterior end of wound represents the 2 centimeters long unsutured area through which blood and serum can escape during first 48 hours after operation. d, Postoperative appearance in patient 4 on 14th day.

many times, but failures annoyingly recurred. It may be that careful attention to certain details, which to some may seem minor, will assist in the attainment of the perfection that we seek. It is confidently asserted that in the treatment of this lesion by primary closure, the attention to such minor details is often the determining factor between success or failure.

#### SUMMARY

Among military personnel, pilonidal cysts and sinuses have provided a problem of major importance. Following the block dissection—open wound treatment, healing and convalescence are prolonged, and recurrence remains an annoying problem.

There are four factors inherent in the lower sacral and coccygeal area which interfere with proper healing, and are conducive to prolonged and ill controlled infection, namely, moisture, heat, motion, and trauma. In the postoperative care of open wounds following block dissection, the following points are stressed: (1) rest in bed, (2) spread rather than approximation of buttocks

accompanied by exposure of wound to sunlight or Quartz lamp radiation, and (3) instructions forbidding walking, sitting or lying supine until the wound is healed.

The re-establishment of typical midline dimples in the line of scar following block excision suggests that this lesion may be acquired as well as congenital in origin. Downgrowth of epithelium below skin level and penetration of deeper tissues by growing hairs during the prolonged healing process may be the cause of such recurrences.

In attempts at excision and primary closure, the greatest stumbling block to good healing is the dead space between skin and sacral and coccygeal fascia.

The most dependable method of primary closure utilizes gluteal muscle-fascia flaps according to the method of Pope, rather than subcutaneous fat to fill in this dead space. Following their mobilization for several centimeters lateral to each lateral edge of the coccyx and lower sacrum, the gluteal musculofascial flaps are approximated in midline by a minimal number of chromic catgut No. 6 sutures including also a bite of the pre-

coccygeal and presacral fascia in its lower half. The skin is approximated by 1 or 2 continuous subcuticular stitches of dermol or steel wire which are removed in 7 to 8 days. The skin is left open for 2 centimeters at its upper or posterior end to permit escape of wound fluid and blood. Drains into the wound must *not* be used.

Chemotherapy including administration of penicillin and sulfadiazine is utilized before, at, and after operation.

Operation is performed with the least possible trauma to tissues: Blood vessels are not crushed, clamped, nor tied in order to reduce to a minimum foreign material and dead tissue in the wound. Fat is not devitalized by encircling sutures. The

less trauma produced in the wound, the better healing and the less infection there will be in this highly vulnerable area.

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## THE USE OF PENICILLIN THERAPY IN CONJUNCTION WITH FREE BONE GRAFTING IN INFECTED AREAS

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**A**MONG the early favorable results obtained with the use of penicillin in the control of infections involving bone, in the University of California Surgical Services, were 2 cases of subsiding acute hematogenous osteomyelitis (hemolytic *Staphylococcus aureus*) in which there was rapid revascularization and incorporation of sequestra in the process of healing of the bone. One case was observed in which a recently infected (hemolytic *Staphylococcus aureus*) Hibb's fusion of the spine containing free iliac bone grafts healed rapidly with penicillin therapy and remained healed without loss of the grafts. These experiences suggested the possibility of bone grafting in areas in which there was chronic infection, or in recently healed contaminated bone defects.

During the past year, 8 patients with infections of the bone in which free bone grafts have been implanted into infected areas have been studied. This study is part of the contract with the Office of Scientific Research and Development for investigation into the use of penicillin in the treatment of bone infections, under the chairmanship of Dr. Howard C. Naffziger, responsible investigator, at the University of California Medical School. The work described herewith has been done in collaboration with the orthopedic surgical services of Dr. LeRoy C. Abbott. Six patients had infected fractures with nonunion that involved the tibia and fibula; one patient had an infected fracture with nonunion of the femur, and one patient had tuberculosis of the knee associated with secondary infection involving the upper end of the tibia, the lower end of the femur, and the knee joint. In all cases the infection was in a chronic or quiescent phase when treatment was undertaken. The pathogenic bacteria cultured from these cases were hemolytic *Staphylococcus aureus* in 4 cases; *Escherichia coli* and hemolytic *Staphylococcus aureus* in 1 case; and beta

hemolytic streptococcus and hemolytic *Staphylococcus aureus* in 2 cases.

Systemic penicillin treatment was given every 3 hours by the intramuscular route preoperatively in 5 cases. In 2 cases the preoperative dosage was 100,000 units per day for 4 and 6 days, respectively. Sulfathiazole was also given in one of the cases in which there was a combination of *Escherichia coli* and hemolytic *Staphylococcus aureus* in the wound. In 1 case the preoperative penicillin dosage was 150,000 units daily for 5 days; in another case 200,000 units of penicillin were given for 1 day before the bone grafting operation. One patient received 100,000 units daily for 37 days and 150,000 units for 5 days before the bone grafting operation. Three patients had no preoperative penicillin therapy.

In 5 cases the bone grafting operation was done in a field in which there were open infected draining wounds or sinuses. In the other 3 cases the grafting was done in areas in which infected wounds had closed recently. All of these patients had had previous operations and were incapacitated with an extremity that was useless because of infection or nonunion, or both. Three of these patients had previously had metal plates inserted for fixation; one of these had been plated twice. In these cases the old plates were removed before the bone graft was inserted. A wound cleaning and trimming procedure had been carried out on all the patients with compound fractures at the time of injury. A "saucerization" had been done without benefit in one case. A previous attempt at free bone grafting in conjunction with sulfa therapy had been made in one patient, but the graft was lost because of infection. The patient with the secondarily infected tuberculous knee joint had had an arthrodesis of the knee joint and a synovectomy at previous operations.

The free bone grafting operations done with penicillin therapy were: (1) insertion of iliac grafts and metal plates, 4 cases; (2) sliding bone graft and metal plating, 1 case; (3) iliac grafts without metal fixation, 2 cases; and (4) sliding graft without plating, 1 case. The bone grafting was done in patients with infected wounds or

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experience indicates, however, that penicillin therapy makes it possible to obtain successful free bone grafting directly in bone defects infected with organisms susceptible to penicillin in which it may be undesirable to wait for preliminary healing. The use of metal devices for internal fixation may be necessary in some of these cases, but they should probably be avoided in contaminated areas unless they are absolutely indispensable to maintain fixation and position. If they are used, it may be desirable or even necessary to remove them after firm union of the bone has been obtained.

In cases in which free bone grafting is done in a contaminated area, penicillin therapy should be regulated with bacteriological studies, including identification of the bacterial flora of the wounds, with frequent cultures and tests for sensitivity of the organisms to penicillin. The presence of penicillin-resistant nonpathogenic organisms has not interfered with free bone grafting in a contaminated bone defect, provided the pathogenic organisms were sensitive to penicillin; however, penicillin-resistant organisms often delay healing in open wounds in the overlying soft tissues.

In cases of bone grafting, the systemic penicillin therapy has been given intramuscularly at 3 hour intervals. It is probably safest to precede the bone grafting operation by at least 3 to 7 days of systemic penicillin therapy. Experience with such cases as well, as with the treatment of other infections of the bone, indicates that postoperative treatment with penicillin should be prolonged for several weeks—usually from 3 to 8 weeks, depending somewhat on the type of organism, the amount of contamination, and the size of the area that must become revascularized during the period of healing after infection is controlled. The dosage of penicillin also varies somewhat with these conditions and should probably be at least 100,000 units daily under the most favorable circumstances, and up to 200,000 units daily, or more, in others. Where the contaminated area is accessible to local penicillin therapy, it appears desirable to instill from 5,000 to 30,000 units daily through a small soft rubber tube, for 7 to 14 days postoperatively. The strictest asepsis should be practiced in handling and injecting the penicillin solution into the tubes. They should probably be removed from the wound by at least the 14th postoperative day, by making a small circular opening in the cast around the tubes. All secondary operations, such as those for delayed closure, removal of plates, or skin grafting, should be accompanied by systemic penicillin therapy for several days before and after the operation.

Primary closure of the soft parts over the grafted bone defect is most desirable. It is reasonably safe and practical if cultures reveal the absence of penicillin-resistant pathogenic bacteria and if it can be accomplished without tension. Primary closure around a small soft rubber tube through which supplementary penicillin is given is even more advantageous when this is technically possible. The presence of penicillin-resistant nonpathogenic organisms does not ordinarily prevent closure and healing, but such bacteria may contribute to the delay in healing of open wounds in the soft tissues. Following operations in areas in which there are penicillin-resistant, potentially pathogenic organisms such as proteus, the wound in the soft parts should always be left open and secondary closure done several days later. In other cases, extensive soft tissue defects may necessitate skin grafting. In all cases in which delayed closure after bone grafting is necessary, it is essential that the wound be protected from contamination from external sources. Such areas should be dressed infrequently and with the strictest aseptic precautions.

Following are summaries prepared from the records of these cases:

CASE 1. A man, aged 43, had a fracture of the tibia for which an open reduction, followed by insertion of metal plates, was performed. The wound became infected and drained for 7 months before he entered the hospital in June, 1944, for penicillin treatment. The fracture site was not united. Bacterial cultures from the wound grew *Escherichia coli* and hemolytic *Staphylococcus aureus*. He received 100,000 units of penicillin intramuscularly daily for 2 days before operation, together with sulfathiazole. The first operation under penicillin therapy consisted of removal of the old metal plate, excision of sinuses and infected scar tissue. The wound was closed without drainage. Postoperatively 100,000 units of penicillin were given daily for 21 days, and sulfathiazole treatment was also continued for this period. The wound apparently healed *per primam*, but 8 days after the administration of penicillin was discontinued, a small area of infection developed and the drainage again contained *Escherichia coli* and hemolytic *Staphylococcus aureus*. A second course of penicillin, 100,000 units daily for 15 days, without sulfa therapy, was given and the wound healed promptly and remained healed. The patient was discharged with plaster fixation for 2 months, after which he returned to the hospital on August 10, 1944, for a bone grafting operation. The wound had remained healed, but there was nonunion at the fracture site. Preoperatively penicillin was administered at the dosage of 100,000 units daily for 4 days. The operation consisted of insertion of a free iliac bone graft with metal plate fixation at the site of the nonunited fracture of the tibia. Postoperatively 100,000 units of penicillin were given daily for 7 weeks. The wound through which the bone grafting was done healed *per primam* and remained healed. However, the old sinus tract was opened during the manipulation and it began to drain on the 10th postoperative day. Cultures grew *Escherichia coli* and beta



Fig. 1. Case 5. X-ray appearance of left knee of patient with tuberculous secondarily infected with hemolytic *Staphylococcus aureus*.



Fig. 2. Case 5. Condition present 3 months after excision of infected joint and insertion of bone grafts under penicillin therapy.

hemolytic streptococcus and diphtheroids. This wound closed gradually and was completely healed by the 26th postoperative day. The patient left the hospital on crutches, with the extremity in plaster, 55 days after entry for the bone grafting operation. His most recent follow up visit was on February 6, 1945. The wounds have remained healed and there is no motion at the fracture site. Roentgenograms show evidence of repair of the fracture site. At present this patient has full weight bearing with out support.

CASE 2. A man, aged 46 years, had an infected fracture of the femur with nonunion of 3 years' duration. There had been 2 unsuccessful attempts at internal fixation with metal plates. He entered the hospital for penicillin treatment on July 10, 1944. Hemolytic *Staphylococcus aureus* and *Streptococcus viridans* were cultured from the sinuses that drained from the ununited fracture site. He was

given 200,000 units of penicillin preoperatively for 3 days. The operation consisted of removal of the old metal plate, excision of sinus tracts, scar and nonviable bone, and insertion of a free iliac bone graft and new metal plates. The wound was closed without drainage. Postoperatively the patient was given 200,000 units of penicillin for 1 day and 100,000 units daily for 17 days. The wound healed *per primam*, and he was discharged with crutches and wearing a brace, after 3 months' hospitalization.

Six months after his operation he developed a small draining sinus from which anaerobic streptococci were cultured. At present he has firm union, and he has reentered the hospital for another course of penicillin therapy and possibly removal of the metal plates.

CASE 3. A man, aged 37 years, had a compound fracture of the tibia and fibula 3½ years ago, with chronic infection following an operation for internal fixation with metal plates. Subsequently the plates were removed and a "saucerization" performed and sulfathiazole therapy given, but the wound continued to drain. The patient entered the hospital for penicillin treatment on July 23, 1944, with nonunion of the fractures and an open, granulating wound from which hemolytic *Staphylococcus aureus* was cultured. Preoperatively 200,000 units of penicillin were given daily for 6 days. At operation, the sinuses, granulations, and infected scar tissues were removed, and a free iliac bone graft and metal plates were inserted. The wound was closed. Postoperatively 200,000 units of penicillin were administered daily for 47 days. The wound developed necrosis followed by a low grade infection due to tension and too great undermining of skin flaps at the site of closure. After the wound became clean, bacteriostasis was maintained with penicillin ointment applied locally for 60 days. On December 18, 1944, the metal plates were removed, and the bone graft was observed to be viable, securely fixed in its position, and well vascularized. The patient received 200,000 units of penicillin daily for 20 days following this procedure. The open wound was covered with an intermediate thickness skin graft on January 11, 1945. The patient left the hospital on June 20, 1945, ambulatory, with an actual weight bearing brace. Apparently he has firm union at the bone grafted fracture site and the skin is healed.



Fig. 3. Case 6. Six months after excision of infected knee joint and bone grafting under penicillin therapy. Wound healed *per primam*. Patient ambulatory with a stable knee joint.



4 cases, beta hemolytic streptococcus and hemolytic *Staphylococcus aureus* 2 cases, *Escherichia coli* and hemolytic *Staphylococcus aureus* 1 case, and *Streptococcus viridans* and hemolytic *Staphylococcus albus* 1 case. Systemic penicillin was given intramuscularly at 3 hour intervals before operations in 5 of the cases, and after operations in all of the cases. The dosage varied from 100,000 to 200,000 units per day. Prolonged treatment extending over many weeks was necessary. The total amount of penicillin used in each of these cases varied from 3 to 8 million units.

The free bone grafting operations consisted of insertion of iliac grafts and metal plates, 4 cases; sliding bone graft and metal plates, 1 case; iliac grafts without metal fixation, 2 cases; and sliding bone graft without metal plating, 1 case. The operative wounds were closed completely in 7 cases and in 1 case the wound was closed around a small soft rubber tube through which supplementary treatment with local penicillin was given. The most recent bone grafting operation was done 3 months ago and this wound has not yet been inspected, but there are no signs of infection and the patient has left the hospital with plaster fixation. Immediate primary healing has resulted in 4 cases; however, in 1 of these cases an adjacent sinus tract reopened following the operation and drained temporarily, and another patient returned for treatment of an infection that developed 6 months after operation. Two wounds developed necrosis and low grade infection resulting from tension at the site of closure, and these have required secondary closure and skin grafting procedures. One wound became infected

and required drainage, but the patient was receiving inadequate doses of penicillin at the time.

At present the wounds of 6 of the 7 patients with grafting operations for infected nonunited fractures are healed completely, and 1 (which became infected 6 months after operation) is under treatment. By x-ray examination the bone grafts in all of these cases appear to be viable and in proper position, but 1 graft in a defect of the tibia fractured 4 months after operation and required a supplementary (fibular transplant) procedure. None of the grafts has sequestered, extruded, or been absorbed. Four patients have firm union of the fracture sites with metal plates still in position, and 2 have firm union without metal plates. One patient has not yet had the original plaster dressing removed, and the remaining patient is the one in which fibular transplant was required because the graft in the tibial defect fractured 4 months after the bone grafting operation.

Even though it has been possible under penicillin therapy to accomplish free bone grafting directly into the infected bone defects successfully in these cases, it is probably more desirable in most instances to attempt to obtain healing preliminary to the grafting procedure by penicillin therapy and, if necessary, operations for removal of sinus tracts, infected granulations, scar, and nonviable bone. The bone grafting may then be accomplished at a later operation in a relatively cleaner field. Adequate dosage with penicillin is a useful adjunct in all such cases in which bone grafting and other operations are done in areas in which there are bone defects infected with penicillin-susceptible organisms.

# THE STRUCTURE OF THE CALCANEAL TENDON (OF ACHILLES) IN RELATION TO ORTHOPEDIC SURGERY

## With Additional Observations on the Plantaris Muscle

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With Surgical Commentary by EMIL D. W. HAUSER, M.D., F.A.C.S.

**I**N connection with surgical procedures designed to lengthen the calcaneal tendon, a knowledge of the constituents of the tendon is of fundamental importance. The manner in which the several contributing divisions of the entire tendon terminate—on the os calcis directly, or as elements without direct insertion into bone—determines the point and direction at which partial transection should be carried out; the local breadth of each band is equally important, because upon this dimension depends the width of the incision necessary to allow the required degree of “slipping.”

### MATERIAL AND METHODS

In the present study observations were upon one hundred specimens of calcaneal tendon, 83 of them in adult cadavers and 17 in adult individuals studied immediately postmortem. From two selected specimens detailed drawings were prepared, of posterior and anterior aspects (Figs. 1 and 2). Specimen A (Fig. 1, a to c) was dissected in such a way that the fascicular structure of the tendon was emphasized; specimen B (Fig. 2, a to c) illustrates particularly the two major and the accessory components of the common tendon of insertion. The data on relationship between the gastrocnemius and soleus components of the calcaneal tendon were shown graphically (Figs. 3 and 4).

Observations on the plantaris muscle were made on 50 specimens, additive to the group of 150 previously reported from this laboratory.<sup>1</sup>

### OBSERVATIONS AND DISCUSSION

#### A. Anatomical Features

1. *General Description.* The superficial group of posterior crural muscles is made of three

Contribution from the Department of Anatomy (No. 451) and the Department of Surgery, Northwestern University Medical School.

<sup>1</sup>Daseler, E. H., and Anson, B. J. The plantaris muscle. J. Bone Surg., 1943, 25: 822-827.

muscles, the gastrocnemius, soleus, and plantaris. As an introduction to the authors' observations their regular anatomical features may be reviewed.<sup>2</sup>

a. *Gastrocnemius.* The ovoid heads of the gastrocnemius, which are structurally similar, take origin from facets above the femoral condyles by aponeurotic bands marginally placed on each head. These bands descend about two thirds of the way down the muscle. The fiber-bundles of the muscle pass obliquely from the supracondylar areas of origin and from the deep surface of the aponeurosis on each side to the tendon of insertion. This tendon begins as a septum between the two heads, and as a lamina on the deep surface of each head. The septum and laminae soon fuse with the broad aponeurosis which covers the dorsal surface of the underlying soleus muscle. The attachment of fiber-bundles continues to about the middle of the back of the leg. The medial head is the broader and thicker of the two, and it extends farther distalward than the lateral head.

b. *Soleus.* The heads of origin of the soleus take origin from the following: the dorsum of the proximal extremity of the fibula and the upper third of the posterior surface of the latter's shaft; the intermuscular septum between the soleus and the peroneus longus and the transverse septum over the distal margin of the popliteus muscle; the popliteal line and the middle third of the medial border of the tibia. Structurally, the fibular and tibial heads arise as broad aponeuroses which unite proximally on the deep surface of the muscle in such a way as to form a fibrous arch over the posterior tibial vessels and the tibial nerve. Continuing distally these aponeuroses diverge and grow narrow, but the fibular element is continued on the lateral side and the tibial aponeurosis on the medial side of the muscle as far as the distal quarter of the leg. The main por-

<sup>2</sup>Bardeen, C. R., in Morris' *Human Anatomy* (9th ed., p. 550).

tion of the belly of the muscle is formed by fiber-bundles which arise from the posterior surface of each of these aponeuroses; descending in an oblique course the fleshy part is inserted, in bipenniform manner, into the deep surface of the calcaneal tendon. This tendon begins as a broad aponeurosis which covers the greater part of the posterior surface of the muscle; its fibers gradually converge to form a heavy fibrous band which is inserted into the calcaneus. The fibers of the tendon are described as taking a slightly spiral course, those on the posterior surface passing from the medial margin toward the lateral surface of the calcaneus, while those on the anterior surface course in the reverse direction. The attachment of the fiber-bundles to the calcaneal tendon continues to within a short distance of the heel. A few of them arise directly from the fibula and from the posterior intermuscular septum. On the deep surface of the belly of the muscle there is an accessory fasciculus which is formed by fiber-bundles that spring on each side from the anterior surface of the aponeuroses of origin of the muscle and have a bipenniform insertion on each side of a thin, oblique tendinous lamina which inferiorly becomes united to the deep surface of the tendon of Achilles.

*c. Plantaris.* The plantaris arises in close association with the lateral head of the gastrocnemius. The fiber-bundles give rise to a flat, short, fusiform belly, and are united to a narrow tendon which extends along the medial edge of the tendon of Achilles toward the dorsum of the calcaneus, where it terminates in any one of several ways (see hereinafter).

2. *Variations.* There is considerable variation in the extent of the separation of the different parts of the triceps surae. The tendinous portions of the gastrocnemius and soleus may be separate almost as far downward as the heel. Either or both heads of the gastrocnemius or the soleus may be doubled. A slip from the biceps or semimembranosus of the thigh, or from the linea aspera, or from the floor of the popliteal space may join the triceps to produce a quadriceps surae muscle. On the other hand, one of the heads of the gastrocnemius or the tibial head of the soleus may be missing. A supernumerary fasciculus may extend from the deep surface of the soleus to the calcaneus. The plantaris is exceedingly variable in origin, structure, and insertion. The origin may be from the capsule of the knee-joint, the fascia of the leg, or from the tibia. None of the variations, recorded above, appeared in the present authors' series of specimens. Its tendon may terminate at almost any part of its

course in neighboring structures. It may be represented by a fibrous band. It is absent in about 7.05 per cent of cases (Daseler and Anson).

The above description of the fleshy portions of the muscles was confirmed by the authors, but more particular attention was focused on the calcaneal tendon, as made up of the tendinous portions of the gastrocnemius and soleus muscles. Most frequently the plantaris tendon is not incorporated in the calcaneal tendon; however, from the surgical aspect it must always be considered as a part of the calcaneal tendon. The tendon as a whole rotates toward the lateral side, as seen from the posterior surface (hence clockwise in the right tendon and counterclockwise in the left).

The gastrocnemius component of the calcaneal tendon begins as a broad aponeurosis at the lower margin of the muscle bellies of the two heads of the gastrocnemius muscle (Figs. 1, a and 2, a). Its fibers converge as they descend toward the insertion on the calcaneus; they rotate at the same time toward the lateral side of the soleus component. At the insertion, the gastrocnemius component not only makes up the lateral side of the posterior surface, but a portion has rotated to attain the lateral aspect of the anterior surface (Figs. 1, b and 2, c).

The soleus component is thicker than that derived from the gastrocnemius. A broad band of fibers begins high on the posterior surface of the soleus muscle and comes into apposition with the aponeurotic band of the gastrocnemius to which it is rather firmly fixed by fascial fibers. This broad band of fibers runs directly over the posterior surface of the soleus, receiving more tendinous components as it proceeds downward (Figs. 1, b and 2, c); it inserts into the medial portion of the tendon. The tendinous portion, as seen from the anterior surface, usually begins as a single band, high up in the muscular portion where it may be concealed by muscle fascicles (Fig. 1, c). This component increases gradually in size as it descends, and courses obliquely medialward (Figs. 1, b and 2, c). Portions of this anterior group of fibers appear on the posterior surface of the insertion of the tendon as a whole (making up the medial segment) (Figs. 1, a, 2, a and 2, b).

It is regularly stated that complete separation may be made between the components (gastrocnemius and soleus) of the calcaneal tendon. Actually, the separation cannot be made absolutely complete, since there is some exchange of smaller bands of fibers between the two (Fig. 1, c). In the experience of the present authors,

<sup>1</sup>Torn fibers in Fig. 1, c are of this type, are shown after separation of the components of the tendon by blunt dissection.

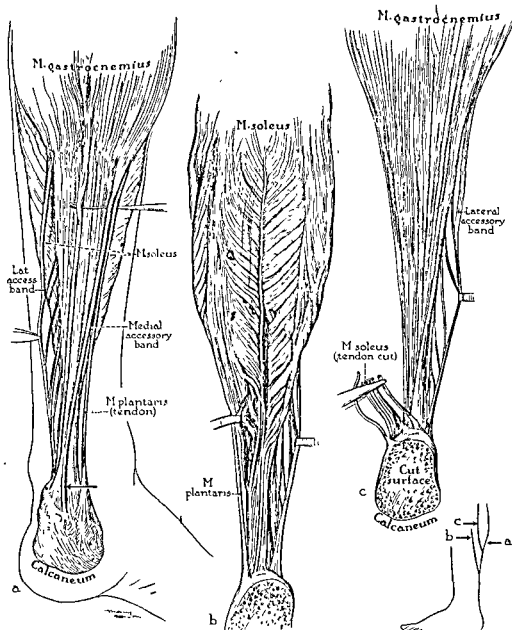


Fig. 1, a to c. Calcaneal tendon, left leg, specimen A (type II). a, Posterior view of calcaneal tendon, with soleus muscle visible beyond margins of tendon and of gastrocnemius muscle. Fibers to reader's left of point of arrow belong to gastrocnemius, those to right are constituents of soleus component of calcaneal tendon. Lateral accessory band of tendon has been retracted by forceps, intermediate and medial bands lifted by probe. Plantaris tendon (of type III) in natural position. b, Anterior view of soleus muscle and calcaneal tendon; os calcis coronally sectioned in front of tendinous attachments. Modified bipenniform character of the soleus is shown, as well as the several bands which emerge from it. c, Anterior view of gastrocnemius part of calcaneal tendon, exposed by removal of soleus part (cut ends of latter held by forceps). Inset records level and direction of view in each figure.

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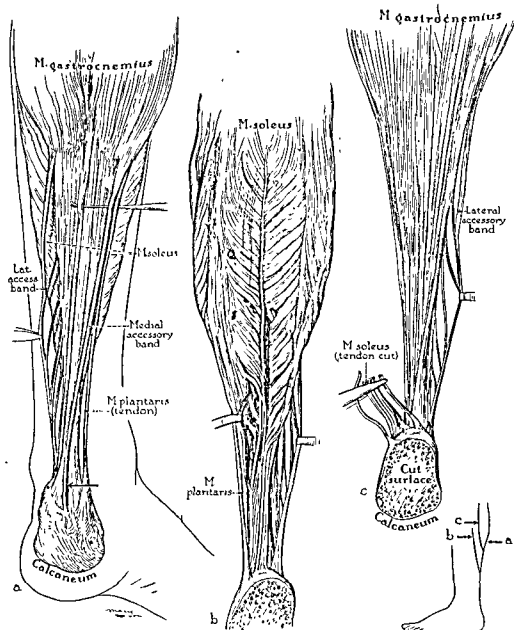


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tendon from which, however, it is separable by blunt dissection. The fasciculus courses along the lateral surface of the tendon to within 12 centimeters of its insertion, where it rotates to the anterior surface of the calcaneal tendon to fan out and occupy the lateral two thirds of the anterior surface at its calcaneal insertion. An intermediate band (Fig. 1, a), located between the two heads of the gastrocnemius, rotates to insert along the lateral margin. This band is not demonstrable in the second specimen. The most medial band (Fig. 1, a), rotates to insert at the approximate middle of the calcaneal tendon, leaving a considerable portion of the soleus exposed on the posterior surface. Here also, in the second specimen, this band appears to arise from the soleus aponeurosis, however, it soon becomes an integral part of the gastrocnemius tendon with practically no rotation of its fibers (Fig. 2, b). As a consequence, only a small portion of the soleus tendon is visible from the posterior aspect (Fig. 2, a and b). The medial fibers of the gastrocnemius component follow an almost parallel course. This band cannot be separated from the remainder of the gastrocnemius tendon as is possible in the case of the lateral band.

Examination of the deep (or anterior) surface of the tendon reveals the degree of rotation of the soleus component (Fig. 2, c), as well as the insertion of the most laterally situated band of the gastrocnemius portion (Figs. 1, b, 1, c and 2, c). The muscle fibers of the soleus extend farther distalward on the lateral side of the tendon and contribute fibers to the tendon to a point 7 centimeters from the insertion.

A thin fibrous sheath envelops the calcaneal tendon; on the deep, or anterior, aspect, the tissue contains a considerable amount of fat. This sheath is adherent to the fibula except for the distal 10 centimeters; from it originates many of the fibers of the soleus muscle. An even thinner lamina, containing almost no fat, separates the muscular portions of the gastrocnemius and soleus and contains the intervening plantaris tendon.

It is clear then, that the components of the calcaneal tendon vary considerably in size, relationship, and rotation. The length of the gastrocnemius component is the longer, varying from 26 to 11 centimeters in length, in contrast to the shorter soleus component which varies from 11 to 3 centimeters in length. The width of the tendon as a whole varies from 2.5 to 1.2 centimeters at insertion.

Rotation is such that, in the specimens examined, the gastrocnemius covers almost entire posterior aspect in some and in others the entire

anterior aspect of the soleus portions (Fig. 3). Some rotation invariably occurs. In order to record degree conveniently, the tendons are arranged in three groups. Group I includes cases of least rotation—in which no more than one third of the tendon posteriorly is contributed to by the soleus, and two thirds by the gastrocnemius. This group comprises 52 per cent of the 100 cases. Group II, including tendons whose rotation is such that approximately one half of the posterior surface is contributed to by each component, represents 35 per cent of the cases. Group III, in which rotation is extreme, so that two thirds of the posterior surface is made up of the soleus and only one third by the gastrocnemius, comprises 13 per cent of the cases. Rotation begins approximately 12 to 15 centimeters from the insertion, or about the level at which the soleus begins to contribute fibers to the tendon. Minimal rotation seems to be associated with lengthy fusion; since rotation occurs only in the "free" portion of the tendon, fusion of the gastrocnemius with a soleus muscle of extensive origin occasions an arrangement which allows the combined tendon to twist only in the distal half of the leg. Progressing slowly at first, the rotation can then become more marked in the lower 2 to 5 centimeters.

In a depression which crosses the posterior surface of the soleus muscle at about the junction of the medial and middle thirds, is lodged the slender plantaris tendon. It remains between the two components of the calcaneal tendon to a point 12 centimeters proximal to its insertion; having attained the medial aspect, it retains that relationship to its insertion (Figs. 1, a, 2, a and c).

When present, the plantaris tendon always occupies a position on the medial surface of the tendon, and varies only in its manner of insertion.<sup>1</sup> In most instances the tendon of the plantaris is found to terminate in a fan-shaped aponeurotic expansion, related to the medial border of the distal extremity of the calcaneal tendon. This and other common arrangements may be conveniently described under the heading of types.

In specimens of type I, representing the commonest mode of insertion of the plantaris tendon (94 of 200 cases, or 47 per cent), the plantaris tendon inserts by a short fan-shaped expansion into the medial extremity of the superior tuberosity for insertion of the calcaneal tendon (Figs. 5, a and 2, a). In some instances the tendon also sends thin slips to the adjacent medial border of the calcaneal tendon. These slips, resembling fascial strands and not true aponeurotic extensions, are

<sup>1</sup>Daseler, E. H., and Anson, R. J. The plantaris muscle. *J. Bone Surg.*, 1943, 25. #22 827.

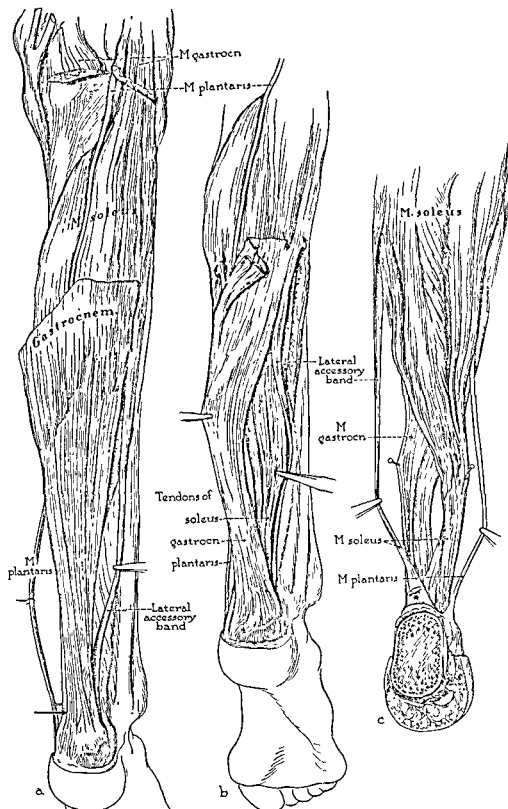


Fig. 2, a to c. Calcaneal tendon, right leg, specimen B (type I). a, Posterior view of calcaneal tendon showing gastrocnemius, soleus, and plantaris muscles; accessory fasciculus retracted to reader's right, plantaris tendon to left. Of calcaneal tendon (type I) small portion to reader's left of point of arrow is soleus component, larger part to right thereof is gastrocnemius division. b, Posterior view of calcaneal tendon showing origin of lateral and medial accessory bands (encircled by curved arrows). c, Anterior view of calcaneal tendon showing lateral accessory band of soleus, major components of calcaneal tendon (drawn apart) and plantaris tendon. Accessory fasciculus attains position on anterolateral aspect of calcaneal tendon, lies deep (anterior) to soleus component of tendon, and terminally forms posterior wall of bursa (at \*).

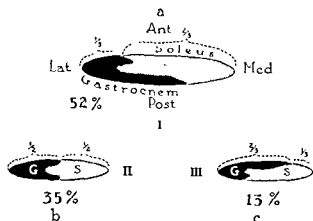


Fig. 3. Diagrams to illustrate degree of rotation of gastrocnemius to soleus portions of calcaneal tendon (as of left extremity), at level of insertion into calcaneus. Occurrence in percentage (of 100 specimens) is indicated for each.

readily removed from the tendon proper. In type II, second in the order of frequency (73 specimens, 36.5 per cent), the plantaris tendon inserts into the calcaneus, 0.5 to 2.5 centimeters anterior to the adjacent margin of the calcaneal

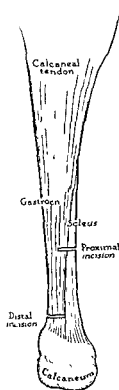


Fig. 4. Diagram to illustrate constitution of calcaneal tendon, showing form of each of its major divisions of the gastrocnemius tendon and subjacent position of soleus tendon. Sites of usual incision (tendon, type II) are indicated.

tendon (Fig. 5, b); the long axis of the tendon is usually at an angle with, not parallel to, the long axis of the foot itself. The insertion supports the anterior wall of the bursa of the calcaneal tendon (Fig. 5, b, at cross). When large, the tendon frequently radiates in fan-shaped manner to the laciniate ligament and the fascia overlying the medial aspect of the calcaneus (Fig. 5, e); tendinous insertions are frequently quite expansive (Fig. 5, c), and often involve the fascial and ligamentous structures on the superior and medial surfaces of the foot. In type III (25 specimens, 12.5 per cent) the tendon is usually broad at the insertion; but, whether of large or medium size, it invests the dorsal and medial surfaces of the terminal portion of the adjacent calcaneal tendon (Figs. 1, a and 5, c). In specimens belonging to type IV (8 cases, 4 per cent) the plantaris tendon inserts chiefly into the medial border of the calcaneal tendon from 1 to 16 centimeters above the insertion of the latter into the calcaneus; occasionally, however, a lowermost slip may reach the bone (Fig. 5, d).

It is clear, then, that the plantaris tendon, in a preponderant percentage of cases, gains a virtually separate insertion into the os calcis. This it may do in any one of three principal ways: by implantation into the os calcis just in front of the calcaneal tendon, the long axis of the line of fixation being parasagittal; by insertion into the bone in such a way that the long axis is almost transverse, beginning, as in the former instance, at the medial margin of the calcaneal tendon; by attachment to the calcaneus medially, or to the calcaneal tendon posteromedially. In the first and second instances, the posterior border of the plantaris tendon is in contact distally with the anterior border of the calcaneal tendon; in the third instance, the lateral, or anterolateral surface is contiguous with the posteromedial surface of the calcaneal tendon. Even in those cases in which the insertion is into the calcaneal tendon, a few fibers may be sent downward for independent attachment to the os calcis.

In the 58 cases of absence of the plantaris in the present authors' series, there are 16 subjects in which agenesis is bilateral, and 26 specimens in which it is unilateral.<sup>2</sup> Thus, in approximately one third of those persons in whom the muscle is wanting, it is bilaterally absent. The muscle is absent on the right side in 23 and on the left side in 35 of the 58 cases. Of the 26 specimens with unilateral absence, 19 are left, while only 7 are

<sup>2</sup>In a series of 881 extremities studied in the Anatomical Laboratory at Northwestern (see Daseler et al.), the plantaris muscle was wanting in 60 cases (7.5 per cent). In sets tabulated from the literature, the percentage absence is 7.05 (187 in 2650).

right. When the muscle and tendon are poorly developed on one side, they are usually equally weak on the opposite side.

### *B. Surgical Applications*

The earliest orthopedic operation recorded is that of lengthening the Achilles tendon. It has become one of the commonest orthopedic procedures. Originally lengthening was accomplished by complete division, following which the gap was filled in by growth of the tendon. Many procedures were later devised. The usual procedure now is the open operation (Z-type tenoplastic) (see Fig. 4). Lengthening can also be accomplished by the subcutaneous method, but in carrying this out many difficulties have been encountered. Irrespective of what method was employed, in certain cases the portions of the divided tendons did not slide as readily as desired; whether the division was taken two thirds anteriorly and two thirds posteriorly, or two thirds medially and two thirds laterally, the results were similarly unsatisfactory.

In the usual open Z-type tenoplastic, the tendon is divided proximally in the medial half and distally in the lateral half, the incisions then connected by a longitudinal cut. After the proper amount of lengthening has been obtained, the tendons are sutured. This has the disadvantages, first, that scar tissue may render the tendon adherent to the skin and underlying structures, and second, that, with a complete division of the tendon, there is no way of controlling the amount of lengthening by "feel." This is important in cases of spastic paralysis since the object is to obtain a better muscle balance between the opposing groups, by weakening the stronger group. The amount of weakening to be obtained can best be judged if the lengthening is taken against the resistance of the tendon. With the subcutaneous method, and through sliding by of the fibers of the tendon (without a complete division), the introduction of sutures is not necessary and consequently there is less reaction. Additionally, the danger of infection is further reduced.

In the anatomical descriptions presented the authors show that in some cases the tendon fibers run practically straight and parallel (Fig. 2, a), while in others there is a complete rotation (Figs. 2, c and 3, c); all intermediate stages can be found, between these extremes (Fig. 1, a). In addition to difficulties occasioned by variation in the course of the fibers, others arise out of failure to divide the plantaris.

The objective of the surgeon is to divide one half of the fibers of the tendon of Achilles proxi-

mally and the other half distally, and at the same time divide the plantaris tendon with the simplest possible procedure.

Rotation of the calcaneal tendon was first brought to our attention by White,<sup>1</sup> who describes it as a constant occurrence which is established during embryological development. Because of this concept he advises sectioning the anterior two thirds of the tendon distally and the medial two thirds proximally. As demonstrated by the current observations, the rotation is variable, not constant. In carrying out White's method it is necessary in certain instances to make a third incision, dividing some gastrocnemius fibers laterally at the same level as the anterior section, in order to permit the severed fibers of the tendon to slide by. This is easily understood when it is remembered that a certain percentage of tendons of type I undergo very slight rotation (Figs. 2, a and 3, a). Therefore, enough of the gastrocnemius fibers remain undivided to require a third section before proper lengthening can be obtained. The method described by White is an excellent procedure in most cases, but unsuccessful in a sufficient number of those cases with slight rotation so that this study was thought advisable. In addition, the technique is difficult to perform subcutaneously, without visualization, because the distal end of the tendon lies deep, making the anterior half accessible only with difficulty. For this reason most surgeons expose the tendon with a longitudinal incision.

To overcome the difficulty just described the authors advise the following procedure. A proximal section is made to divide the posterior two thirds of the tendon (the gastrocnemius portion) (Fig. 6, b), and a distal one to separate the medial two thirds (the soleus fibers, including the plantaris tendon) (Fig. 6, c). In this way all of the fibers are severed either at the proximal or distal level, except in those cases in which there is virtually no rotation of the tendon. In such instances there are a few lateral fibers of the soleus left undivided at the level of the proximal incision. Since these fibers are mainly muscular, due to the extensive distalward site of origin (Fig. 2, c), they are readily torn (Fig. 6, d). As a consequence, the tendon is allowed to slide by, and desired lengthening is easily achieved.

The technique consists in a sterile preparation of the skin, and insertion of a thin tenotome (Fig. 7, a), scalpel-like, through the tendon so that two thirds of the tendon lies posterior to the tenotome. The tenotome is inserted so that the

<sup>1</sup>White, J. Warren. Torsion of the Achilles tendon; its surgical significance. *Arch. Surg.* 1943, 46: 784-787.

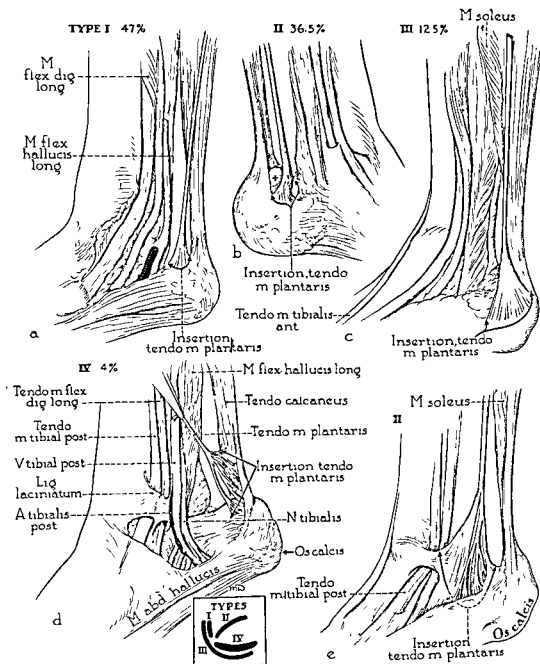


Fig. 5, a to e. Types of tendinous insertion of plantaris muscle (adapted from Daseler and Anson, and augmented); specimen in Figure 5, b is of the left extremity, those in Figures 5, a and c to e are of the right. Bursa in 5, b is indicated by cross. Insert indicates areas of calcaneal insertion of plantaris tendon (types I, II and III) and of combined calcaneal and plantaris tendon (type IV), with areas of insertion numbered to record types. In insert tendon for type IV represented is an unusually long example. For tendon of type II, one of intermediate position is diagrammed; others would lie in front of or behind area indicated.

blade is parallel with the tendon. Next, the blade is turned so that it faces posteriorly, and the tendon is cut through toward the skin. Palpation by the thumb is used as a guide to the position of the

blade. The second incision is made distally by means of a curved tenotome (Fig. 7, b). The blade is inserted deep to the medial two thirds of the tendon. The tenotome is then drawn poster-

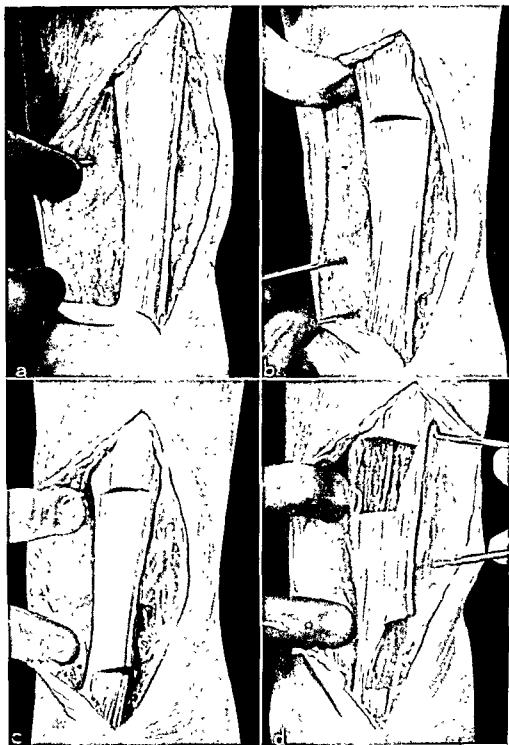


Fig. 6, a to d. Photographs (retouched) of surgical case, illustrating steps in procedure of tendon lengthening. Left leg. a, Calcaneal and plantaris tendons in position; fibers course laterally and counterclockwise. b, Proximal incision, with gastrocnemius and some soleus fibers divided. c, Distal incision dividing plantaris and remainder of soleus fibers. d, After moderate dorsiflexion of foot, showing sliding by of tendon segments and accessory fasciculus of soleus at the center of proximal incision.

iorly and medially to divide the medial two thirds of the tendon. The distance between the two divisions can vary from 1 inch to 4 or 5 inches, depending on the amount of lengthening required. The proximal incision should be made a

distance of 3 to 5 inches from the insertion of the tendon into the calcaneus, depending upon the amount of increase desired in the length of the tendon. The distal division of the tendon is always made at least one-half inch above the in-



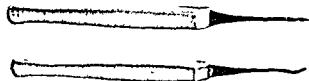


Fig. 7, a and b. Photograph of tenotomes used. a, above, Used for proximal incision. Blade length 1.3 centimeters. b, Curved tenotome used for distal incision. Blade length 1.0 centimeters.

section of the Achilles tendon; in this way the tendon of the plantaris muscle is always included in the second incision. After the tendon has been divided in this manner, little force is required to lengthen the tendon, since the fibers will slide by quite readily. Judgment is required to establish the proper degree of lengthening. In cases of spastic paralysis the resistance present under anesthesia is a factor to be considered. The amount of correction can be measured by the amount of dorsiflexion taken. Palpation of the gaps in the tendon is also serviceable in establishing the degree of lengthening. Postoperatively the extremity is put in a cast to retain the new position and to allow the tendon to heal with retention of its increased length. A little less than the full correction obtained by surgery is to be maintained by the cast, in order to avoid undue strain and to prevent the formation of pressure sores.

In brief, then, the authors recommend the closed technique for lengthening the calcaneal tendon wherever its employment is possible. Basing a judgment upon an extensive anatomical study of cadavers and of postmortem specimens, and after considerable orthopedic experience, the authors feel justified in recommending their modified form of a well known surgical technique.

#### SUMMARY

In a group of one hundred lower extremities the constitution of the soleus and gastrocnemius tendons and of the combined calcaneal tendon was studied. Typical specimens are illustrated.

Some rotation of the gastrocnemius to the lateral side occurs in every case. The degree of rotation varies from slight (to render the soleus just visible in dorsal view), to extreme (causing the soleus component to be nearly obscured from the ventral surface). Cases of extreme rotation are far less common than those in which moderate rotation obtains.

Ability to separate the two components likewise varies from a condition in which it can be carried out with ease to one in which segregation is practically impossible. The width and length of the two components likewise vary to a marked degree.

The plantaris muscle and its tendon are subject to considerable variation in both origin and insertion. From an examination of 200 lower extremities, the authors set up four types of tendinous insertion. In a total of 810 consecutive lower extremities examined by the authors, the plantaris muscle is absent in 58 (7.16 per cent). In one third of the specimens in which the muscle is missing, the absence is bilateral.

Various types of transverse incisions were made on exposed tendons and ability to cause "slipping" by moderate dorsiflexion of the foot noted. From these observations, subsequently established clinically, it is concluded that if the posterior two thirds of the tendon be sectioned proximally and the medial two thirds distally, the desired degree of lengthening can be produced. It is also concluded that, by subcutaneous tenotomy rather than a more extensive tenoplastic procedure, it is possible for wholly satisfactory results to be obtained.

# FOREIGN BODIES IN, AND IN RELATION TO, THE THORACIC BLOOD VESSELS AND HEART

## I. Techniques for Approaching and Removing Foreign Bodies from the Chambers of the Heart

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**T**HE purpose of this short discussion is to outline briefly a few aspects of the problem of foreign bodies in relation to the thoracic blood vessels and heart. Principal attention will be given: first, to the location of the missiles, second, to some reasons for the surgical removal of such bodies, and third, to the technique of approaching and removing fragments from the chambers of the heart. The necessity for brevity will dictate certain dogmatism and even the use of unsupported statements. Further clarification and support are to be presented (1, 2).

During the past 10 months with the thoracic unit of the 160th General Hospital 78 missiles were removed from within or in relation to the great vessels, at least 3 of which were embolic. During the same period 56 foreign bodies in, or in relation to, the heart have been removed, 13 of which were in the chambers of the heart. The great vessel series of 78 cases and the cardiac group of 56 cases, represent a total of 134 patients and 139 operations. There have been no deaths. A more precise breakdown in the distribution of these missiles is as follows: pericardial, 26; involving pericardium but principally pulmonary, 17; intracardiac, 13; on great vessels (and in walls), 35; intravascular (3 embolic), 7; on great vessels but principally pulmonary, 17; mediastinal but not directly on great vessels, 19, a total of 134, with no deaths.

The first diagram (Fig. 1) is a scale drawing of the heart and great vessels presenting the approximate size and location of a few of the foreign bodies first removed in the Unit. The gray shading represents a position impinging on the indicated structure, cross-hatching signifies an embolus and black indicates removal of foreign body from within the structure designated.

A current diagram (Fig. 2) has been prepared but in representing 129 missiles it has been neces-

sary to use point localization only. The same key to location is used in the margin, gray for foreign bodies impinging on the structure, cross-hatching for the embolic missiles and solid black for those lying within the structure outlined.

About all that such a gross method of localization conveys, is that the foreign bodies occupied a variety of positions, diffusely distributed about the mediastinum but that only one was found to lie in the left ventricle and none within the lumen of the thoracic aorta. It is, therefore, assumed that the direct entrance of foreign bodies of surgical size into either of these structures is rarely sur-

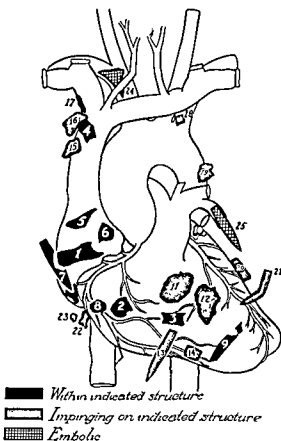


Fig. 1. A scale drawing of some of the first missiles removed in this clinic. Gray shading, impinging position; cross hatching, an embolus; black, within structure designated.

From the 160th General Hospital.  
Presented at meeting of the Association of Surgeons of Great Britain and Ireland, May 2, 1945.

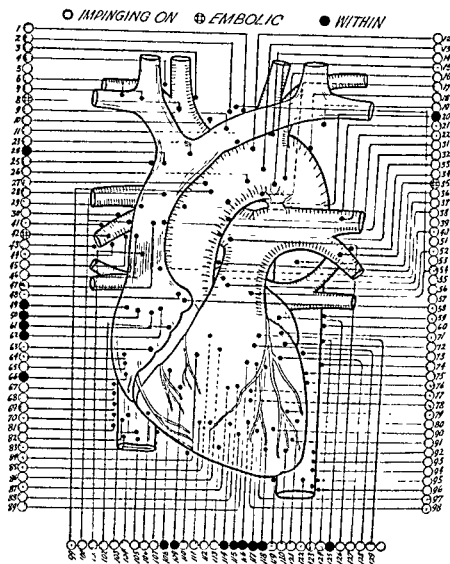


Fig. 2. Gross localization of foreign bodies presented in this discussion. Gray, impinging; cross hatching, embolic missiles; black within structure

vived. It is further suggested that fragments small enough to enter the left ventricle as migrating missiles are swept along by the high systemic pressure in contrast to those arriving at the right ventricle.

#### FOREIGN BODIES IN OR ON GREAT VESSELS

The danger of erosion and suppuration attending large retained missiles in relation to thoracic blood vessels is real. Three deaths from massive hemorrhage due to erosion have come to our attention. Furthermore, approximately 15 per cent of the thoracic vessel foreign bodies in our series have been associated with abscess formation, just

over 30 per cent were associated with other foreign material such as cloth or bone and 67 per cent showed pathogenic bacteria on culture. It is therefore, our policy to remove all foreign bodies measuring one or more centimeters in two dimensions, at times smaller missiles are taken out. The technical aspects of finding such fragments at operation are insignificant. We have failed in only one instance and that, the third case in this clinic. The fact that there have been no deaths supports our contention that removal is safer than retention.

In passing, attention is called to the three foreign bodies that have been established as embolic;

one was from the liver to the left pulmonary artery, another traveled from the heart to lodge in the innominate artery, and the third shifted from the left to the right pulmonary artery. All of these were removed without incident and with restoration of vascular continuity. These will be reported in detail separately (1).

#### FOREIGN BODIES IN OR ON THE HEART

Of the 56 foreign bodies in, or in relation to, the heart 13 have been removed from the chambers of the heart. The locations of the missiles in the chambers of the heart are indicated in the photograph (Fig. 3). Four were in the right auricle, 7 were in the right ventricle, 1 was in the left auricle and 1 was in a small cystic myocardial hernia of the left ventricle.

One fragment listed as within the right auricle lay in the interauricular septum and was associated with systemic embolus producing hemiplegia. Another fragment, described as in the right ventricle, was more evasive than the others (LeR.R. in Fig. 3). At the first operation with the patient in the dorsal decubitus position, the fragment wriggled from the grasping forceps and migrated to the right auricle just over the opening of the inferior vena cava. Three months later at the second cardiectomy the missile, though surgically exposed and visualized fell from the auricle into the right ventricle—the direction of fall being influenced by the patient's left lateral decubitus position. Finally at the patient's request a third cardiectomy was performed and the fragment was trapped in the apex of the right ventricle and successfully removed. The patient is now apparently in robust health. The last operation was recorded in colored moving pictures which demonstrate the firmly healed cardiectomy of the

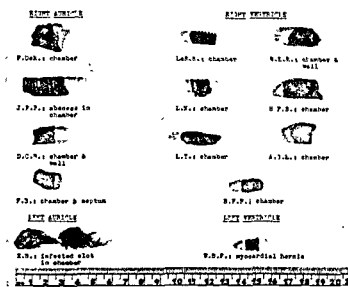


Fig. 3. Photograph of intracardiac missiles that have been removed.

first operation and an area of damaged wall over the last intracardiac resting place of the migrating missile. This case demonstrates that even migrating foreign bodies can damage the overlying heart wall.

In spite of isolated reports of asymptomatic foreign bodies lodged in the heart, there is also evidence in the medical literature that some do cause death. These reports together with experimental evidence were the early basis for a policy of surgical intervention. It was found that foreign bodies placed inside the hearts of animals were associated with subsequent bacterial endocarditis. With such a background it was elected to remove 13 of 28 intracardiac foreign bodies. *It was felt that certain foreign bodies should be removed:* (1) to prevent embolus of the foreign body or the associated thrombus; (2) to reduce the incidence of

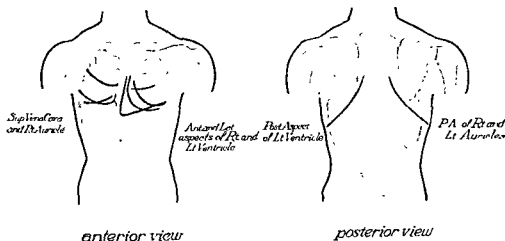


Fig. 4. Some of the incisions, indicating the variety of approaches used to obtain adequate direct exposure.

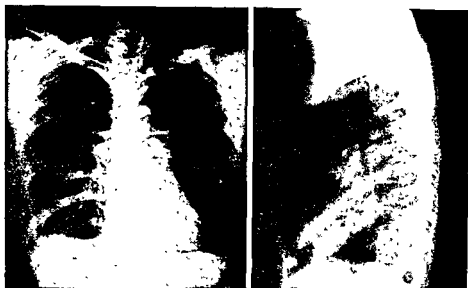


Fig. 5 Anteroposterior and lateral views of a foreign body in the chamber of the right ventricle. The right hemithorax was cleared of an infected hemothorax by decortication before these pictures were taken.

bacterial endocarditis; (3) to avoid recurrent pericardial effusions; and (4) to diminish the danger of myocardial damage with subsequent rupture or myocardial aneurysm.

It is now fair to say that this rationale originally borrowed from the medical literature and partially confirmed by personal animal experi-

mentation, has been clinically established. The evidence cannot be reviewed here, but will be further elaborated in a later publication (2).

Inevitably size and location are factors influencing surgical intervention. Small foreign bodies are probably less hazardous as they may be associated with less myocardial damage, they are

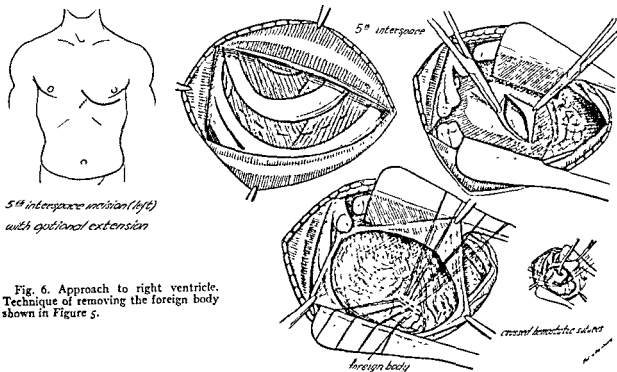


Fig. 6. Approach to right ventricle. Technique of removing the foreign body shown in Figure 5.

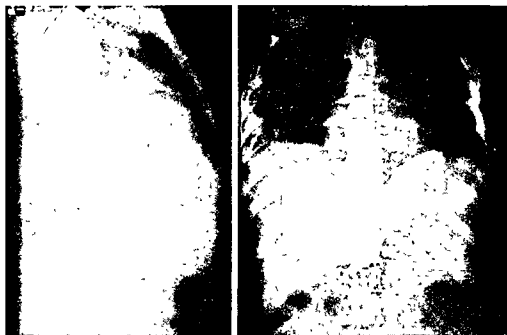


Fig. 7. A missile is shown to lie in the right auricle.

more readily and more firmly encapsulated and, finally, small foreign bodies are technically more difficult to remove. Accordingly in this clinic, the retention of 15 foreign bodies apparently in the heart has been regarded as less hazardous than their surgical removal. In short, Figure 3 illustrates the foreign bodies that we have elected to

remove. Size alone dictated removal of some of these, whereas, attending clinical manifestations influenced the decision to intervene in others.

Once the decision to remove a missile from the heart is made, the technical considerations are contingent upon surgical exposure and safe removal at cardiotomy.

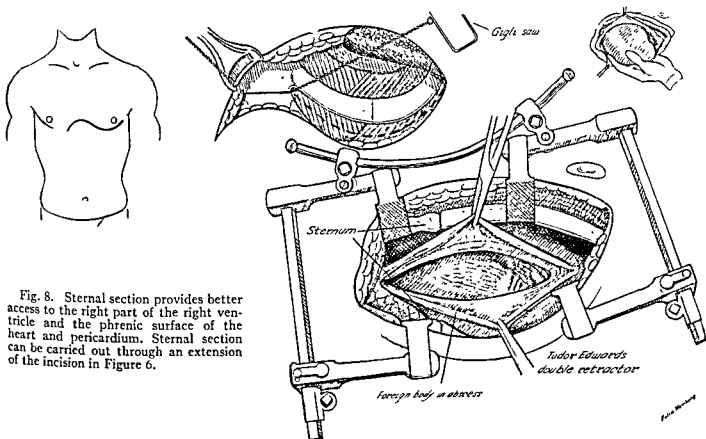


Fig. 8. Sternal section provides better access to the right part of the right ventricle and the phrenic surface of the heart and pericardium. Sternal section can be carried out through an extension of the incision in Figure 6.

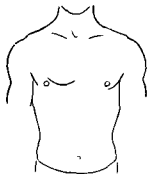
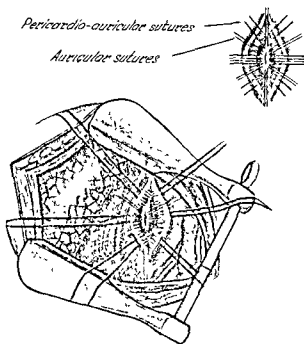


Fig. 9 The technique of approaching and exposing the fragment shown in Figure 7—anterior approach to the right auricle.



#### SALIENT FEATURES OF CARDIAC EXPOSURE

1. Adequate direct exposure of the involved region. This wide, direct exposure necessitates the use of a variety of approaches (Fig. 4) each one focused on the immediate problem at hand. This means that no standard or set cardiac approach is relied upon. The pleura is routinely opened.

2. Conservation of thoracic cage skeleton. The free division of ribs, cartilage, and the sternum is often essential; but complete reconstruction of an intact chest wall at end of operation must be borne in mind. Nothing is resected, nor discarded.

3. Minimal dislocation of the heart from its position of optimum function. Dislocation, manually or by means of an apical suture is badly tolerated and has caused runs of ventricular extrasystoles, diminished cardiac output, and transitory bundle branch block. Cardiac surgery with minimal dislocation of the heart, indeed, taxes the versatility of approach first emphasized.

4. Maintenance of a moist epicardium in the exposed heart. One per cent novocain solution has been used to keep the epicardium moist. It may have additional advantages.

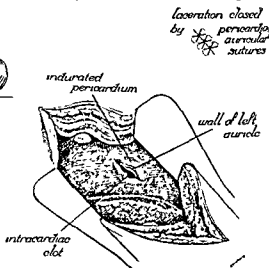
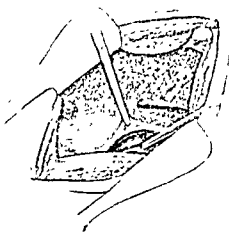


Fig. 10. The approach used to remove a missile from the left auricle.



Fig. 11. A posterior approach to the heart is shown. The patient is in the ventral decubitus position.



Bearing in mind these principles of cardiac approach the left part of the right ventricle and the left border of the left ventricle have been exposed through the fifth or fourth intercostal space (Figs. 5 and 6). The pectoralis major muscle is split laterally and divided medially. The intercostal muscles are divided and the internal mammary vessels ligated. The suprajacent cartilage is divided near the sternum and the rib spreader inserted. Additional exposure can be obtained by the optional "T" incision and the division of the sixth and seventh costal cartilages (see Fig. 6). The pericardium and pleura are then opened freely. The foreign body can then be palpated if

it is in the right ventricle. Ordinarily we would not open a chamber of the heart to attempt removal of a missile not precisely located by palpation. Immediately over the foreign body a row of sutures is placed on either side of the projected incision. These are the hemostatic guy sutures or the control sutures by which the assistant prevents blood loss in the opened heart between intracardiac maneuvers. Actually we place two rows of control sutures on each side of the incision. The second row is a second line of defense as one of the first row is often pulled out. The missile is stabilized as well as possible with the fingers, a small epicardial incision is made with the



Fig. 12. A foreign body is shown in the interauricular septum and right auricle. The widened mediastinum was found, at operation, to be due to hematoma.



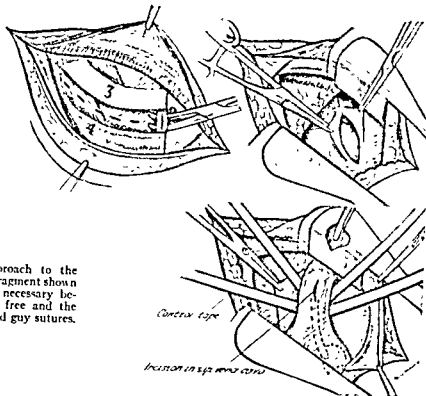
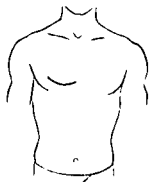


Fig 13. An extracardiac approach to the right auricle used to remove the fragment shown in Figure 12. This avenue was necessary because the pericardial space was free and the auricular wall was too thin to hold guy sutures.

scalpel and a pointed forceps is thrust through the myocardial wall and spread to make an opening large enough to allow the insertion of a Kocher clamp. The foreign body is then grasped and extracted with the Kocher instrument. During these manipulations, the assistant affects hemostasis by crossing the control sutures. Once the foreign body has been removed, the inner rows of control sutures are tied across the incision. The second line of sutures are then tied over a free pericardial graft. Finally a larger free pericardial graft is placed over the first. No. 00 chromic catgut sutures on atraumatic noncutting needles are used. It is possible that silk would be preferable for use in closing the left ventricle. Postoperative cardiac tamponade is avoided by leaving the lateral angle of the pericardial incision open into the pleural space.

When the region to be approached is farther to the right or on the diaphragmatic surface of the heart, the intercostal incision is combined with transverse sternal section (Fig. 8). Mr. Tudor Edward's double retractor can be adapted for use in this procedure as illustrated. The sternum can be readily reconstituted with wire. When the auricle or the right side of the ventricle is to be approached, the reverse of this incision on the right side of the chest can be used in precisely the same way.

In approaching the right auricle ordinarily the right anterior approach is best, the third, fourth, or even fifth interspace being used, depending on the location of the foreign body. In the operation illustrated in Figures 7 and 9 the third interspace was used with section of the third and fourth costal cartilages near the sternum to gain exposure of the upper portion of the right auricle. In such approaches to the right auricle after the pericardium is opened, control sutures are placed in the auricular wall similar to those in the ventricle. As the auricular myocardium is often too thin to hold the sutures, the pericardium may be included with the auricle in the outer line, if there are existing adhesions as in this case.

A foreign body in the left auricle was approached as indicated in Figure 10. The fusion of the auricle to the pericardium made the intracardiac portion of this operation quite simple. The laceration of the auricle and pericardium was plugged by an infected clot. This patient had had three major and two minor hemorrhages.

A posterior approach exposing the left auricle either on the right or left side has been used to remove intrapericardial missiles but not for an intracardiac operation to date. The patient is placed in the ventral decubitus and the posterior incision provides exposure as illustrated in Figure 11.

In one instance an extremely thin walled auricle was encountered in a completely free pericardial space. The auricle bled when an attempt to place the hemostatic sutures was made and this technique had to be abandoned. Similarly an approach through the auricular appendage was found unsafe. In this instance an extracardiac approach was devised by exposing the superior vena cava (Figs. 12 and 13) control tapes were placed around this vessel, an incision was made as illustrated and a forceps was slipped down the lumen into the auricle. By this maneuver the missile was removed without difficulty.

All of these approaches have been used successfully. Another extracardiac avenue to the heart by way of the pulmonary veins to the left auricle or even left ventricle has appealed to us but no occasion to use it has arisen.

Throughout these operations electrocardiograms have been taken, and these tracings are helpful in determining which manipulations are badly tolerated by the heart. Comments about these findings must be deferred.

Although the electrocardiogram may return to normal within a few hours, the patients who have had *ventricular* cardiomy are kept in bed for 3 weeks.

#### SUMMARY AND CONCLUSIONS

1. A series of 78 foreign bodies that have been removed from within, or in relation to, the

thoracic great vessels is discussed. Three of these were embolic.

2. A series of 56 foreign bodies that have been removed from within or on the heart is discussed. Thirteen of these were removed from the chambers of the heart.

3. Indications for the removal of certain great vessel and cardiac foreign bodies are discussed.

4. The salient features of cardiac exposure are presented.

5. Various techniques and approaches are outlined for removing foreign bodies from the chambers of the heart.

In conclusion it is again emphasized that the mortality and morbidity rates for retained foreign bodies in and in relation to thoracic blood vessels and the heart have not been completely assessed. However, in our series of 134 patients who have had foreign bodies removed, there have been no deaths and the men are clinically well. We hope that this experience supports our therapeutic policy.

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# FRACTURES OF THE UPPER END AND SHAFT OF THE HUMERUS

## A Simple Conservative Method of Treatment

LAURENCE JONES, M.D., Beverly Hills, California

**I**N October 1942 (1) there was reported, in considerable detail, a reconstructive plastic operation made necessary by a previous resection of the head of the humerus. This operation was indicated when fracture dislocation of the head was present, or when severe comminution made satisfactory reduction impossible.

It was stated that this operation was reserved only for cases in which conservative measures had failed. In actual clinical experience the conservative treatment succeeded in at least 90 per cent of the total number of cases. This conservative method, previously undescribed, varies quite radically from other reported methods of treatment. It has been modified repeatedly over a period of 20 years. Because of a recent change of address, it is impossible at this time, to collect case reports of a rather large series of cases. However, the difficult nature of the illustrative case history should serve to demonstrate the efficacy of this method. It should also be apparent that the method would be applicable to other cases of simpler types. The comparative advantages of this treatment will be discussed briefly.

Mr. D. L. H., aged 66 years, slipped on the sidewalk falling directly on the point of the left shoulder. The arm and forearm were not extended. Immediately thereafter he noticed extreme pain in the left shoulder joint, aggravated by any movement. The patient was removed to the hospital and roentgenograms were made. These showed a badly comminuted fracture of the head, with overriding of the shaft (Fig. 1a). An abduction splint of special design (to be described in considerable detail) with incorporated

bracket for skin traction was applied. This bracket was designed to hold two lateral and parallel adhesive skin bands. After 2 days there was little or no improvement in position. Realizing that skeletal traction was necessary a short Steinmann pin was drilled through the olecranon process of the ulna, and a yoke and different bracket were applied to the abduction splint (Fig. 2a and b). Through this device about 10 pounds of spring traction was applied. The angle of the brace was changed several times until the lower fragment was finally placed in satisfactory alignment with the upper comminuted fragments. All of this was checked by roentgenograms (Fig. 1 b, c, d). Within a week practically complete anatomical reduction had been obtained. Patient became ambulatory and was discharged home.

Two weeks after insertion, the Steinmann pin was removed. To prevent angulation and loss of position, the splint itself was not removed until firm bony union could be demonstrated by roentgenograms. This occurred approximately 3 months after date of initial injury. In the interim, patient received physical therapy consisting of ductothermy and massage. No active or passive motion was permitted until firm bony union was demonstrated. Photographs taken 3 years after injury show that patient could carry 30 pounds of sand bags in full abduction (Fig. 3 a). A painless range of motion had been regained, patient's sole disability consisting of inability completely to extend injured arm overhead (Fig. 3 b, c, d).

The abduction splint (Fig. 4) which occupies such a prominent place in this discussion has been modified many times over a period of 20 years. It has become an indispensable addition to the armamentarium of conservative treatment of several conditions. Certain of its features are believed to be original, others were adapted from certain improvements found in other abduction splints. In clinical practice it is used for treatment of fractures of the clavicle. In addition, it has



Fig. 1 a, Photograph of roentgenogram illustrating fractures at, and above, the surgical neck with marked comminution of the head and overriding of the shaft. b, c, d

Photographs of serial roentgenograms illustrating gradual improvement in position following application of abduction splint.

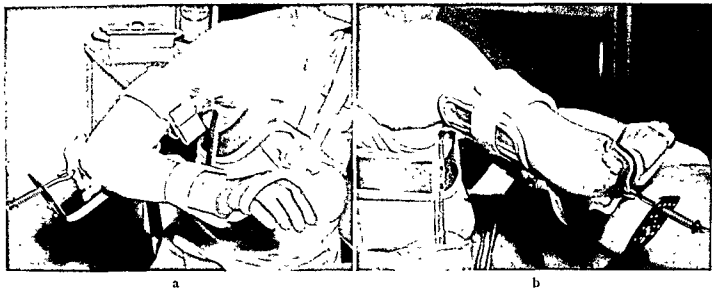


Fig. 2. a, b, Photographs illustrating actual application of skeletal traction in recent patient having a fracture through the surgical neck of the humerus. These two views

show ambulant treatment and skeletal traction by Steinmann pin or Kirschner wire. Also improved bracket and yoke with details of spring traction regulated by wing-nut.

been found that immobilization of the shoulder promptly relieves severe pain which accompanies incomplete ruptures of the supraspinatus tendon. These are usually termed subacromial, or subdeltoid bursitis. Compared to other abduction splints it is very light, the frame weighing only slightly more than 2 pounds. This light weight is due to the fact that the frame is made of duralumin, or of thin sheet steel if this is not obtainable. All the various parts can be adjusted to the body contour by simple hand bending. Similarly, the angle of abduction can be adjusted. In treatment of fractures, the bracket in Figure 2a, b is added.

There is no need to describe in detail all of the features of the splint, such as the cock-up forearm splint, the elbow lock, the cupped-up arm rest, and the special design of the pelvic rest, as the accompanying photographs and illustrations do this adequately (Figs. 4a, 4b, 4c, 2a, and 2b). However, particular attention should be called to the key strap which starts at the upper bar posteriorly, and attaches to the lower bar anteriorly. This is always the first strap adjusted and has been called the "key strap." Adjustment of this strap assures a snug fit of the brace to the axilla. Also attention is called to the curve in the

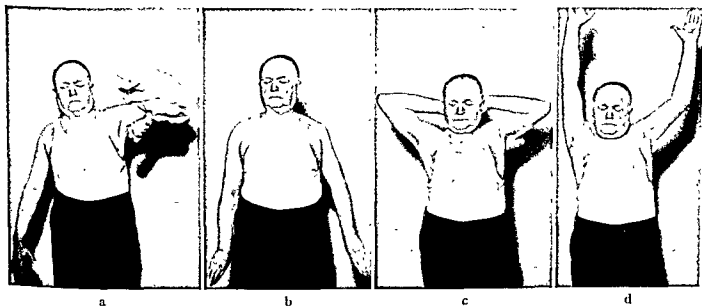


Fig. 3. Photographs illustrating extent of functional return. a, Photograph illustrating patient carrying 30 pounds of sand bags in full abduction. b, Illustrating

complete return of external rotation. c, Illustrating complete return of internal rotation. d, Sole disability is inability to completely elevate arm to the overhead position.

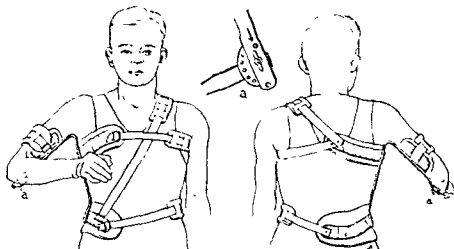


Fig. 4. a, left and b, right. Anterior and posterior views of abduction splint with special built-in feature. The anterior view illustrates the two bands connected by a vertical connecting bar. When possible, the entire splint is made of duralumin. It weighs a little more than 2 pounds completely equipped and is easily adjusted by simple hand bending. The upper arm band is curved upward anteriorly to avoid pressure on the female breast. The lower body band is designed to fit on the curve of the crest of the ilium. The forearm is curved upward anteriorly under the palm to give a "cock up" feature. The elbow lock, a, is adequately illustrated and capable of fixation or movement as desired. Special attention is called to the "key strap." This is the first strap adjusted and starts at the outer posterior end of the upper arm band and runs to the anterior surface of the lower arm band. The remaining straps pass circularly about the parts. (One central forearm strap is not shown in the illustration.) The frames can be used over and over again with only the felts and straps being changed. The splint can be reversed, for use on opposite side, by a brace shop.

anterior portion of the upper body band. This feature, now present in all the braces, is most valuable for the female patient. A band fashioned in this manner does not press upon the breast.

There has been little difficulty in getting the patients to wear this splint, even in cases other than fractures. Once fitted properly over an undergarment, the patient can then dress over it with a loose fitting dress, coat, or sport clothes, so that only the hand piece is visible; patients are pleased by this fact. This advantage does not apply while skeletal traction is necessary.

It has been our experience in fractures involving the upper two-thirds of the humerus, that lateral displacement of fragments is rarely a problem. Expressed in another manner, once the fragment is satisfactorily aligned in the anteroposterior roentgenogram, lateral views will show a satisfactory reduction in the great majority of cases.

Other methods of treatment for fractures of the upper end of the humerus and types of apparatus used are described in the various textbooks that concern fractures and dislocations. Many of these methods confine the patient to bed for the duration of the fracture; certain others, require the use of heavy plaster casts with incorporated devices for traction. Some, by their very nature,

prohibit the use of physical therapy during the treatment. As a result, circulation is impaired. This, in turn, often may result in delayed union and limitation of neighboring joint movements.

#### SUMMARY AND CONCLUSIONS

1. A simplified treatment of fractures of the upper two-thirds of the humerus is described.
2. The method has been used for a long period.
3. It has been found to be a satisfactory treatment for the great majority of fractures affecting this area. An illustrative case history is reported. Ordinarily this fracture would have required open reduction but it was treated conservatively with a good end-result. Approximately 90 per cent of fractures in this area can be treated by this simple ambulatory method.
4. An abduction splint that has been redesigned many times is described. In addition to the other uses, it has been found to be helpful in the conservative treatment of certain types of fractures of the clavicle, and in the relief of the pain that accompanies incomplete ruptures of the supraspinatus tendon (subdeltoid bursitis).

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# EDITORIALS

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JULY, 1946

## SURGERY AND THE CANCER PROBLEM

**A**N appeal is being made to the American public for sums aggregating several millions of dollars for a "fight against cancer." The cause is a worthy one, but distribution of money collected in its name entails considerable responsibility.

In general, cancer research has been interpreted to mean laboratory investigation with spontaneous and transplantable tumors, genetic studies, observations on the metabolism of cells *in vitro*, the chemistry of carcinogens, hormones, etc. Much basic information has been obtained concerning the nature of neoplasia; and such studies must be continued and expanded. However, unlike the situation in the fields of infectious and metabolic diseases where laboratory investigation has often afforded immediate benefit for clinical practice, cancer research has yielded comparatively little of direct benefit for the sufferer with cancer.

Great discoveries may come suddenly and from unexpected quarters; at the moment there is little indication that a biologic method for prevention and cure of cancer is imminent and there appears to be no one field that justifies intensive concentration of material resources and research effort at the expense of all other phases of the general problem.

Knowledge of cause does not assure means for control. It became possible to control the spread of small pox before the general acceptance of the germ theory of disease and long before the development of modern immunology. The specific cause of tuberculosis has been known for decades yet no specific therapy has been devised.

The endeavors of surgeons over the years to meet the challenge of cancer have resulted in appreciable advances in treatment. Six decades ago cancer of the breast was almost invariably fatal; today the patient with early cancer is offered at least a "60 per cent chance" for cure. At the turn of the century cancer of the stomach was regarded as hopeless. An interesting paper by no less an authority than the late William H. Welch, written in the eighties, four years after Billroth's first pylorotomy, included a discussion of why the surgical attack against cancer of the stomach was doomed to failure. Each one of the "insurmountable" obstacles mentioned has since been partially or completely surmounted. Today, the patient surviving five years following gastrectomy for cancer is no longer a medical curiosity. Fifteen years ago the patient with cancer of the lung, lower esophagus, proximal stomach, or pancreas was regarded as hopeless merely by

virtue of the location of the growth; today operations for removal of these neoplasms are carried out in many centers and patients have survived for years. Furthermore, improvement in cancer surgery based upon advances in supportive treatment permits appreciable extension of life in comfort for some patients belonging to a group previously regarded to be in the terminal stages of the disease. Indeed, prolonged survivals among them are increasing as time goes on. Irradiation therapy and radiobiology stem directly from an empirical clinical application of radium and x-rays to superficial neoplasms.

These endeavors must not be classified merely as phases in the routine care of patients by clinicians engaged in the routine practice of their profession. They constitute "cancer research" of a type, and no small measure of success has been attained.

The cause of cancer may be closely associated with the "cause" of living protoplasm itself and it is possible that sufficient fundamental knowledge of mechanisms of causation to enable control is still in the far future. Besides, as heretofore pointed out, knowledge of cause does not necessarily afford the means for control.

In the meantime the sufferer from cancer cannot await the future solution of the cancer problem. His situation is urgent and must be met immediately with the means at hand. With few exceptions, the only hope for cure lies with surgery, undertaken in the early stages of the disease; and for the exceptions, with irradiation, properly carried out. By continually improving the surgical and irradiation treatment progress will be made. If advances in the next 2 decades in the surgical management of cancer are comparable to those of the past 20 years, another important forward step will have been achieved which will be of direct benefit for the sufferers of this

disease. Appreciation of the proper place and importance of surgery in "the fight against cancer" is necessary in any plans for an extensive project along these lines. Failure of such appreciation would tend to restrain the further development of the one method of treatment with wide application that has been increasingly successful throughout the years and which along with irradiation in selected cases may continue to be the only generally effective therapy for a long time to come.

ALEXANDER BRUNSCHWIG.

### A PLEA FOR THE PERSONAL CASE RECORD

ONE of the paradoxes of the day is the degree of ignorance concerning personal health and past illnesses found in the majority of individuals. A man who knows with certainty the exact status of a bank account, income tax, social security, insurance programs, et cetera, is conversely uninformed about the state of his present health and the true history of his previous illnesses. This deficiency is apparent on a review of the medical histories related by patients on successive hospital admissions or when the details are secured independently by two or more physicians. The errors in this information held by the patient are more obviously revealed by consulting the hospital records of past admissions. For example, the average patient does not know the operative findings, the nature of complications experienced, the proper final diagnosis, and the laboratory data of any surgical procedure performed on his person.

If one were to live in the same community from birth to death and always utilize the one community hospital and remain under the all-inclusive care of one doctor during this period, the present editorial and suggestions would be

unnecessary. In this age, however, almost every adult has consulted a number of physicians for various purposes, and each doctor is confronted with the problem not only of the chief or present complaint, but the condition of the patient as a whole and the relation of the present illness to past diseases or the handicaps of a body influenced by such past diseases. He may be content with a verbal report by the patient or he may deem it sufficiently important to consult the previous hospital records. In emergencies, there may be no opportunity to secure any information whatsoever.

The possession of a written, accurate personal health record or medical diary is as valuable as any birth certificate, wedding license, genealogical tree, diploma or any other treasured document. It can be achieved only by the meticulous accumulation of such information during one's lifetime.

Such a volume could start with the hereditary factors of familial diseases and list the causes of death of near relatives. From then, in orderly sequence could be related the type of birth and incidents in child development, such as ages at teething, walking and talking and the rate of growth. The diseases of infancy and childhood would be followed by those of adolescence, adulthood and senility in year by year notation. Each visit to a physician for minor illnesses would be recorded by the physician himself in a brief paragraph stating the diagnosis and treatment.

A separate sheet in the case record book would be used for noting the dates of vaccinations, tests for immunities, injections of sera and allergic reactions. A dental form

would be a corporate part of the system with the details of extractions, dental restorations and oral infections written by the dentist. All laboratory data such as urinalysis, blood counts, blood chemical studies, stool, sputum, blood typing, basal metabolic determinations would be listed on proper sheets with exact dates for future references.

In the case of females, the menstrual, gynecological, and obstetrical histories would be given in separate detail in the personal case record book. Pocket sheets for electrocardiographic tracings and miniature reproductions of roentgenograms would be integral parts of the record.

With each hospital admission the case record book is submitted by the patient and attached to the hospital chart until the day of discharge. An accurate summary of the past illnesses could be made by the interne without interrogating the patient. When patient left the hospital, a discharge note would include the exact diagnosis, the course of the disease, the complications, the surgical procedures and operative findings, if the treatment were surgical, the pathological diagnosis of any specimen removed and all laboratory and radiographic reports; this summary would be the responsibility of the attending physician.

Personal case records of the type described would be of great value to the patient and to the physician as well. They would have economic value because of the avoidance of so much unnecessary duplication of case recording. Such records would constitute an important source for statistical study if the method were commonly employed.

GEORGE T. PACK.



# THE SURGEON'S LIBRARY

## REVIEWS OF NEW BOOKS

THE author of *Plaster of Paris Technique*<sup>1</sup> believes that anyone with a moderate degree of manual dexterity can learn how to apply a plaster-of-Paris cast. He states correctly that the plaster cast is the best splint at the surgeon's command. It is inexpensive, durable, and is form fitting. It is a form of splint that renders itself to any specific situation.

Comparatively little has been written on the subject but the author calls especial attention to Luck's writings.

This book is written for students, house officers, and those who are called upon to treat injuries. The manuscript is well written. The illustrations are instructive. The book is divided into four sections: general considerations, the upper extremity, the lower extremity, and the vertebral column.

The author advises (1) no padding other than stockinette; (2) careful molding over bony prominences; (3) avoidance of wrinkles; (4) avoidance of adhesive beneath casts; (5) avoidance of any circular bandage other than sheet wadding under a cast; (6) application while bandage is sloppy wet; (7) no pulling during application.

He emphasizes the importance of pain, numbness, cyanosis, anesthesia, and edema as danger signals of complications. He believes it is unnecessary to split all casts immediately after application as a routine procedure.

The application of the full arm splint is well illustrated.

There are very few who would fail to enjoy and profit by reading this book. It should be in every plaster room and in every orthopedic library.

PHILIP LEWIN.

MANY new selections have been added to *The Classic Descriptions of Disease*<sup>2</sup> by Ralph H. Major which have definitely enhanced its value, though many a reader would doubtless wish to include still others depending on what his special interests are and who among the immortals are his favorites. One can derive much pleasure through reading the 287 selections from the original accounts of 195 authorities. These selections include a wealth of material of value to the practicing physician, teacher, and student.

The subjects chosen are divided into infectious diseases; diseases of metabolism; lead poisoning;

diseases of the circulatory, blood, kidney and respiratory systems; deficiency diseases; allergic diseases and diseases of the digestive tract.

In some of these chapters perhaps more is included than is necessary; in others, one could wish for more. Obviously there is no limit to the amount of material that could be included, and the author must be congratulated on the selections he has made. This volume deserves commendation and is a worthy addition to the physician's library.

THEODORE R. VAN DELLEN.

THE medical profession is provided with an excellent coverage of world's literature in the field of radiology by offering in *The 1945 Year Book of Radiology*<sup>3</sup> concise but lucid abstracts of selected articles with adequate illustrations. In this the 50th anniversary year of the discovery of x-ray by Roentgen, with the world in turmoil, when the needs of the armed forces depleted the number of physicians in civilian practice to a bare minimum, it is gratifying to note the excellence and number of contributions published in the past year.

A perusal of this volume will acquaint the reader with the progress and latest achievements in diagnostic roentgenology and radiation therapy. It should stimulate him to refer to original articles for more detailed discussions. In collecting this material, the editors have selected 314 contributions from 91 clinical scientific publications of the United States and 16 other countries. The volume of 464 pages with 342 illustrations is well bound, and printed and comprehensively indexed.

Radiologists will not fail to add this volume to their library and look forward from year to year for its publication. To those physicians not familiar with the excellent content of the book, it is recommended without reservation. EARL E. BARTII.

THE manual entitled *Roentgen Diagnosis of Diseases of the Gastrointestinal Tract*<sup>4</sup> is the outgrowth of mimeographed outlines which the author John T. Farrell, used for some years in teaching students in radiology in the Graduate School of Medicine of the University of Pennsylvania.

The text is presented according to the "Standard Classified Nomenclature of Disease" published by the American Medical Association. Each pathologi-

<sup>1</sup>PLASTER OF PARIS TECHNIQUE; IN THE TREATMENT OF FRACTURES AND OTHER INJURIES. By T. B. Quigley. New York. The Macmillan Co., 1945.

<sup>2</sup>CLASSIC DESCRIPTIONS OF DISEASE, WITH BIOGRAPHICAL SKETCHES OF THE AUTHORS. By Ralph H. Major, M.D. 3d ed. Springfield, Illinois. Charles C. Thomas, 1945.

<sup>3</sup>THE 1945 YEAR BOOK OF RADIOLOGY. Edited by Charles A. Waters, M.D., and Whitmer H. Ewart, M.D. The Year Book Publishers, Inc., 1945.

<sup>4</sup>ROENTGEN DIAGNOSIS OF DISEASES OF THE GASTROINTESTINAL TRACT. By John T. Farrell, Jr., M.D. Springfield, Illinois. Charles C. Thomas, 1946.

cal condition is described in terms of alterations in contour, motility, and position.

The topics discussed include: esophagus; stomach; small intestine; colon; appendix; rectum; anus; combined diseases of the stomach and intestine and diseases of the intestine.

The methods of examination are presented at the beginning of each topic. A summary at the conclusion of each chapter classifies the diseases according to their effect upon contour, motility, and position.

This book is recommended as an excellent guide in the examination and diagnosis of diseases of the gastrointestinal tract.

R. B. LEWIS.

IN the small monograph, *Renal Tuberculosis and Roentgenologic Examination*,<sup>1</sup> Steinhert presents a survey and a discussion of the different diagnostic methods employed in the examination of 60 cases of surgical renal tuberculosis with special reference to the roentgenologic diagnosis. The material consists of the cases of patients with renal tuberculosis who were admitted into the Ulleval Hospital from 1938-1941. The value of excretory urography and the dangers which may attend instrumentation are discussed. An interesting and informative chapter is devoted to a discussion of renal reflux or back flow. The author advocates the application of pressure for adequate visualization of urinary tract by the excretory method. Short case histories of the 60 patients studied are found at the end of the volume. The literature, both European and American, is well covered. The illustrations are in the negative phase and depict all stages of renal tuberculosis.

The monograph—an instructive monograph deserving recommendation to urologists and roentgenologists as a valuable addition to their libraries—is translated into English with the summary translated into both French and German.

EARL E. BARTIL.

IN the monograph, *Cerebral Angiography with Perabrodil*,<sup>2</sup> Engset has compiled the material from 1940 to 1944 at the Neurological Department of the University Clinic of Oslo. Since thorotrast was not accepted as being absolutely harmless, 35 per cent perabrodil has been used satisfactorily as the contrast substance since 1938. Thorotrast is used only when perabrodil produces pain and for patients with mental disorders. From 6 to 20 cubic centimeters per injection and from 6 to 52 cubic centimeters per scan are used. The material covers the author's experience in performing angiographies on 100 patients with a total of 190 injections. Patients with mental disorders often react violently so thorotrast is used instead of perabrodil. Death occurred in two instances. One patient in coma was

<sup>1</sup>RENAL TUBERCULOSIS AND ROENTGENOLOGIC EXAMINATION. A SURVEY AND A COMPARISON BETWEEN THE EFFICIENCY OF THE DIFFERENT DIAGNOSTIC METHODS IN SIXTY CASES OF SURGICAL RENAL TUBERCULOSIS. BY RAREG STEINHERT. Oslo: Grøndahl-Trylle, 1943.

<sup>2</sup>CEREBRAL ANGIOGRAPHY WITH PERABRODIL (CAROTIS ANGIOGRAPHY). BY ARNE ENGSET. Oslo: Fabritius & Sønners Boktrykkeri, 1944.

subjected to both ventriculography and angiography and expired a few hours later. The other patient, suffering from malignancy of the kidney with intracranial metastases, was subjected to angiography in the final stage of the illness. In neither instance was the cause of death ascribed to the injection of perabrodil.

In discussing the subject the author devotes sections to a historical review, to a comparison of contrast substances, to indications, contraindications, and technique; to the anatomy of the blood vessels, tumor localization, type diagnosis; to cerebral angiomas, cerebral aneurysms, cerebral arteriosclerosis and carotid thrombosis, and to therapy. The injections were all made by the neurosurgeon, Torkildsen, or his assistants. Brief case histories including a description of x-ray findings and excellent illustrations in the negative phase are used in presenting the clinical material.

The presence of several corrections is not found to be confusing. The volume is recommended to neurosurgeons, radiologists, and physicians interested in this specialized procedure.

EARL E. BARTIL.

IN this excellent monograph, *The Radiosensitivity of the Bone Marrow*,<sup>3</sup> Denstad discusses a subject of much interest and vital importance not only to the radiologist but to all physicians who recommend the use of irradiation in the treatment of malignant and benign lesions. The work of previous investigators is adequately evaluated. The author has investigated both the indirect and the direct effect of irradiation.

The majority of the patients studied were undergoing radium and roentgen treatment for malignant tumors and lymphogranulomatosis at the Norwegian Radium Hospital. The methods of irradiation and hematological technique are discussed. The author concludes that irradiation does not generally produce any changes in the nonirradiated bone marrow. If the irradiation produces granulocytopenia, however, a minor degree of maturation inhibition is found within the myelopoiesis which is regarded as the cause of granulocytopenia, since fewer neutrophilic granulocytes capable of migration are found in the bone marrow. The anaphylactic or toxic factor probably has an inhibitory effect on the myelopoiesis stimulating the erythropoiesis. The indirect irradiation effect may possibly occur more easily in patients who are debilitated or whose erythropoietic mechanism is impaired prior to treatment.

In investigating the direct effect of irradiation on bone marrow, the author found the parenchymatous cells to be very sensitive. Doses of 100 r produced slight transient changes. The erythroblasts are somewhat more sensitive than the myeloid cells and the megakaryocytes. The youngest cell forms disappear early followed by the older forms when the dosage is increased. Early inhibition of karyokinesis was noted. Complete aplasia occurs after doses of

<sup>3</sup>THE RADIOSENSITIVITY OF THE BONE MARROW. BY TORFEN DENSTAD. Oslo: Centralitykkeriet, 1943.

2000 to 3000 r. Regeneration occurs early after small doses but later and more incompletely after larger doses. Complete regeneration has been observed after doses of 2000 to 3000 r. Only after larger doses of 3000 r or more is regeneration less complete, particularly the quantity of cells. Complete aplasia was found  $3\frac{1}{2}$  years after the administration of 12,000 r. Erythroblasts regenerate first followed somewhat later by the myeloid cells. No difference in the effect of large doses of radium and x-ray was found. Irradiation produces inhibition of mitosis, a forced pathological maturation of the erythroblasts and disturbances of maturation within the myelopoiesis, all of which persist far into the period of regeneration.

This excellent monograph dealing with a subject of vital importance to any physician attending patients receiving either x-ray or roentgen therapy is highly recommended.

EARL E. BARTII.

THE third edition of *Gynecologic Nursing*<sup>1</sup> by Crossen and Hoffert has been written to fit in with the type of texts advised by the National League of Nursing Education. Its purpose is twofold: first, to teach the principles of gynecology to nurses so they may intelligently carry out various methods of examination and treatment and, second, to teach them gynecologic nursing methods.

This book of 256 pages is replete with 104 illustrations, glossary, index, and list of reference works. The authors believe that if nurses are well grounded in the theories and principles of gynecology, they may better understand the significance of diseases of the reproductive system as they pertain both to the individual and the community.

The book is divided into two parts; the first covering anatomy, physiology, disease and treatment; the second, outlining the nursing care of the gynecologic patient. Anatomy and physiology are dealt with in a simple, concise manner, terms are defined, and often lay terms are used to clarify the text. A wealth of illustrations placed close to the subjects under discussion make for easy reference. Important names and subjects are highlighted in heavy print for easy reference to the glossary where pronunciation and definitions are given. Review questions are given at the end of each chapter.

Symptoms and their significance, history, and examination are explained from the nurses' point of view, and the names and definitions of the many types of examination and their uses in differentiating gynecologic diseases are given. The entire field of gynecology is covered in the first two-thirds of the book, the latter third being reserved for the more strictly technical nursing care of the patient. Rather detailed operative procedures are fully discussed and explained. A healthy crusading spirit is noted throughout the text for the periodic examination and early treatment of pelvic disorders.

Under the nursing care section, detailed instructions discussing nursing care are given both regarding equipment and instruments needed as well as their use during the various gynecologic procedures. Many well placed illustrations admirably clarify the text, particularly in the discussion of subjects difficult to describe.

The sociologic, public health, and industrial problems are carefully covered. This volume is an excellent adjunct to nursing education.

BYROND HOFFERT.

THE book entitled *Synopsis of Gynecology*<sup>2</sup> by Crossen and Crossen is based on the 9th edition of the textbook *Diseases of Women* by the same authors. These authors believe that a synopsis is particularly valuable to students who intend to do general practice and to those intending to go into specialties other than gynecology because of the mass of material they must absorb from all other fields and because it offers a well digested, time saving method of becoming acquainted with gynecological disorders. Students specializing in gynecology will have a standard text on the subject, and the synopsis will offer them a small pocket review which can be read at odd moments.

This little volume, although in small print and very concise, frequently outline in form, is nevertheless quite detailed in many respects, often giving the background and early research involved in various subjects. With some 132 illustrations and 3 color plates well placed to aid in clarifying the text, there is a wealth of material crowded into this half inch thick volume. It is written with the student viewpoint in mind.

The early chapters cover anatomy and physiology of the pelvic organs including their endocrine functions, giving the background as well as modern concepts. Examination methods, both physical and laboratory, are well covered with descriptive illustrations liberally interspersed with the text. Diagnosis is thoroughly reviewed, with the signs and symptoms and their significance in localizing particular disease entities. Under treatment a note of caution is stressed in the indiscriminate use of the endocrines. Two full chapters deal with the external and lower genital tract including such subjects as relaxations and fistulas.

Several chapters are devoted to a discussion of the uterus, and they also cover inflammations, displacements, malignant and nonmalignant tumors. Pelvic inflammatory diseases are dealt with in two separate chapters outlining etiology, pathology, diagnosis, and treatment. There is one full chapter devoted to diseases of the ovary which include cysts and tumors. Menstrual disturbances are thoroughly gone into, and methods of investigation and treatment in relation to the various age groups are given. Sterility, sterilization, contraception and

<sup>1</sup>Gynecologic Nursing. By Robert James Crossen, A.B., M.D., F.A.C.S., and Frances W. Hoffert, R.N., B.S., 3d ed. St. Louis: The C. V. Mosby Co., 1945.

<sup>2</sup>SYNOPSIS OF GYNECOLOGY. Based on the Textbook Diseases of Women. By Harry Stauffer Crossen, M.D., F.A.C.S., and Robert James Crossen, M.D., F.A.C.S., 3d ed. St. Louis: The C. V. Mosby Co., 1945.

premarital examinations are explained in considerable detail. Two chapters deal with miscellaneous subjects such as menopause, allergic disturbances, leucorrhea and the relationship of other body organs to the sexual organs.

Operative gynecology is covered in detail, both abdominal and vaginal, giving indications, dangers, preoperative and postoperative care. A final chapter deals with medicolegal problems.

The specialty of gynecology is thoroughly reviewed in this book. The authors state they do not include obstetrical problems, although one believes some space should be devoted to the cause and treatment of abortions and the early complications of pregnancy because in most hospitals these patients are cared for on the gynecological service.

BYFORD HESKETT.

THE author of *Biological Actions of Sex Hormones*,<sup>1</sup> Harold Burrows, is a well known experimental investigator who has written extensively on the nature and effects of the sex hormones. This book was written because the author believed, "that a coordinated summary of experimental inquiries in this field might be useful."

The book is divided into six sections. Part one is concerned with the gonadotrophins or the gonad stimulating hormones. Strictly speaking, gonadotrophins are not sex hormones but their inclusion in this book seems more than justified. The function of the gonads and their production of sex hormones is dependent upon and in turn has an effect upon the gonadotrophins. Part two has to do with a general consideration of the gonadal hormones: estrogens, androgens, and progestins; comparing and contrasting their chemical structure and the nature of their effects.

Part three deals more specifically with androgens, part four with estrogens and part five with progestins. The final section is entitled "The Sex Hormones of the Adrenal Cortex" and deals with the adrenal-gonad relationships. Adrenal "virilism and feminism" are also discussed.

There is a very complete index, both as to subject and authorities quoted. The latter serves as well for a bibliography, a method of presentation which has always seemed more sensible to the reviewer than having separate bibliographies at the end of each chapter or section of a book.

Burrows' review of the literature on each subject is exhaustive and in most portions the data is reviewed in a critical manner and the significance of the experimental work is evaluated. Only rarely does he compile the data on a subject with no attempt to evaluate its significance. One suspects these latter subjects are those with which he is less familiar or those which have been of no particular interest to him.

The book is well organized and well written but it probably will be of interest or of value to a very

limited audience. The data considered are almost exclusively those obtained from laboratory animals. On most subjects little or no clinical data are included. Inferences and conclusions drawn are physiological and rarely have clinical application. On the other hand the book will be of extreme value to the laboratory worker and to the rare gynecologist or endocrinologist who attempts to keep himself informed of the basic knowledge in his particular profession.

RONALD GREENE.

THE literature of hypertension and hypertensive disease has become voluminous and its evaluation difficult for the average physician. Herndon's slim book *An Introduction to Essential Hypertension*<sup>2</sup> provides an excellent introduction to the subject and should facilitate critical appraisal of current and future contributions in this field. Important and recent work is reviewed and included in an extensive bibliography. The author's conclusions are conservative. Essential hypertension is viewed as a deep-seated constitutional disorder affecting the whole vascular system. The etiology still appears to be unknown, and diagnosis is reached by the exclusion of other conditions. Modern study of the disease requires the skills of an internist, ophthalmologist, urologist, pathologist, and surgeon. Present treatment is merely palliative, and the disappointing results of medical care have stimulated a surgical attack of the problem. The effect of lowering the blood pressure is obviously beneficial. The most satisfactory surgical procedure, at present, seems to be bilateral section of the splanchnic nerves with lower dorsal and upper lumbar sympathetic ganglionectomy. Although an operation of this kind fails to remove the cause or alter the fundamental disturbance, it is believed worth while in certain carefully selected cases. The need and value of the patient's learning to live with a chronic condition is stressed. The author defines clearly and concisely the present status of our knowledge of an important and complex problem.

WALTER H. NADLER.

THE author of *Digitalis and Other Cardiotonic Drugs*,<sup>3</sup> Eli Movitt, presents a useful manual.

Although the literature on digitalis has been extensive, it has embraced a host of conflicting findings and opinions, and no attempt has been made since the appearance in 1936 of Luten's treatise, to compile the sounder elements of clinical and laboratory research under separate cover. The book is organized under eight headings: (1) digitalis folium; (2), digitalis lanata; (3), lanatoside C; (4), other cardiotonic glycosides from digitalis plants; (5), strophanthus; (6), squill; (7), other cardiotonic agents of plant origin; and (8), cardiotonic glycosides of animal origin and a cardiotonic alkaloid. Each section contains a readable and orderly account of

<sup>1</sup>AN INTRODUCTION TO ESSENTIAL HYPERTENSION. By Richard F. Herndon, M.D., F.A.C.P. Springfield, Illinois: Charles C Thomas, 1946.

<sup>2</sup>DIGITALIS AND OTHER CARDIOTONIC DRUGS. By Eli Rodin Movitt, M.D. New York: Oxford University Press, 1946.

<sup>3</sup>BIOLOGICAL ACTIONS OF SEX HORMONES. By Harold Burrows, C.B.E., Ph.D., F.R.C.S. Cambridge: At the University Press, 1945.

chemical structure, pharmacology and clinical application. Opinions and impressions of authoritative origin have been included with reasonable completeness and discretion on contested aspects of the subject. A few glaring errors in proofreading mar a serviceable and timely book.

EDITH B. FARNSWORTH.

**I**N the excellent book, *The Chemistry of Anesthesia* by Adriani<sup>1</sup> the author reviews the fundamental science, chemistry, and presents its significant relationship to anesthesia in an interesting and comprehensible manner.

In part I the author discusses inorganic chemistry as it applies to anesthesia. Special emphasis is placed on the chemical absorption of carbon dioxide in rebreathing appliances. The two types of mechanisms, the to-and-fro and the circle, are illustrated with simple explicit diagrams. Many practical aspects are included, such as, the temperature change during absorption of carbon dioxide, the resistance to movement of gases, and the clinical efficiency of soda lime.

Part II is devoted to the chemistry of the depressant drugs in common use for clinical anesthesia. The hydrocarbons as a group produce general anesthesia but variations in structure within this group alter potency, toxicity, or may even entirely remove physiological activity of the compound. There is a wealth of detail concerning the methods of preparation, properties, impurities, and chemical tests for ethylene and cyclopropane.

In the chapter on the alcohols one finds the basic information on changing narcotic potency, water solubility, and volatility by altering the structural formula. The chapter on ethers includes a chart showing the use of ethyl ether as the basic raw material in the manufacture of anesthetic drugs, and the wide distribution of the ethyl radical in the commonly used anesthetics. The importance of the purity of ether is stressed and tests for noxious agents and contaminants are described.

Halogenated compounds and the chemical and physical changes which occur by halogenation are discussed in detail. In the chapter on local anesthetic drugs there is a valuable table which included 20 different preparations comparing them as to chemical nature, solubility, and properties. Similar attention is given to the drugs affecting the autonomic nervous system and to the anaesthetics. The subject of explosions—factors influencing their production and the limits of inflammability—is treated briefly.

Part III deals with the biochemical aspects of anesthesia, i.e. the chemical changes in tissues induced by the administration of anesthetic drugs to man and animals. Animal experiments are wisely mentioned only when those on men are not available. Most theories of narcosis are based upon chemical, physical, or physicochemical phenomena observed

in cells. Each theory of narcosis is interrelated, and for this reason the entire subject is complicated. The author suggests that we may now have a few links to the still incomplete chain explaining the depression of the central nervous system. Then follows a description of the three separate compartments of body fluids—the vascular space, the interstitial fluid space, and the intracellular spaces—and the effects which anesthesia can have on the constituents of these fluids. There is also valuable information on the effects of anesthesia upon liver function, nervous tissue, and composition of urine.

Enzymes, vitamins, and hormones may play important rôles in anesthesia, and the data which exist at the present time are lucidly recorded. There is a thorough discussion of the detoxification and the elimination of anesthetic drugs.

The bibliography is especially fine in that it not only lists references according to the section of the book, but lists them according to each specific subject. It is a bibliography which can be used repeatedly. A glossary of terms, tables, and other information is also provided.

This book fills an important place in the library of the anesthesiologist. Heretofore it was necessary to search through many periodicals and books to find the material which is accumulated in this manuscript. Although it is basically for the anesthesiologist it has more than casual interest for the chemist, pharmacologist, and research worker. It is well written and well organized, and the subject becomes alive and comprehensible to the reader.

LOITH EASON and MARY KARP.

**I**N its second edition, *Modern Anesthetic Practice* is a member of *The Practitioner Handbook* series has been completely revised. Like the first, it is planned for the occasional anesthetist, rather than the specialist. The contributors include the leading English anesthetists who have arranged a manual of basic principles which will be of value to the general practitioner to whom it is addressed. The specialist, however, will also find helpful suggestions.

The introduction warns that though the advantages accruing from the increasing complexities of anesthetic apparatus are obtained at a price; the simpler methods are safer for those not specially trained.

A brief outline of the essential physiology is included and the use of volatile agents, which is the chief reliance of the occasional anesthetist, is considered in some detail.

This reviewer feels that too much emphasis is placed on the use of nitrous oxide in major surgery and that the technique described, that of secondary saturation, introduces unjustifiable hazards of anoxia. In the hands of the occasional anesthetist, this technique may be even more dangerous than its use by the specialist.

<sup>1</sup>*MODERN ANESTHETIC PRACTICE*. Edited by The Late Sir Humphry Rolleston, Bt. G.C.V.O., K.C.B., M.D., F.R.C.P., and Alan Moorhead, M.D., F.R.C.P., 2d ed. Published on behalf of *The Practitioner* London: Eyre and Spottiswoode Ltd., 1946.

<sup>1</sup>*THE CHEMISTRY OF ANESTHESIA*. By John Adriani, M.D. Springfield, Ill.: Charles C. Thomas, 1946.

The drugs and methods of administration of basal narcosis are described, including the administration of pentothal sodium rectally and intravenously. The discussion of endotracheal anesthesia is comprehensive.

In the chapter on spinal anesthesia it is recommended that the use of this method by the practitioner be confined to operations on the lower half of the body.

Considerable attention is given to the various phases of anesthesia and analgesia in obstetrics and it is stressed that spinal and caudal anesthesia for obstetric procedure should be reserved strictly for the specialist working under favorable conditions.

Premedication and methods of anesthesia for the child and for dental operations are discussed in detail.

Local anesthesia and refrigeration anesthesia are covered too sketchily for practical advantages. The anesthetic aspects of postoperative care are treated briefly, as are explosion hazards.

In general, the methods and apparatus described are applicable primarily to surgical practice in Great Britain and the American practitioner's interest will be largely academic.

MARY FRANCIS POE.

THE volume *Medicine in Industry*<sup>1</sup> by Bernhard Stern is one of the series published under the auspices of the Committee on Medicine and the Changing Order of the New York Academy of Medicine. The author is a lecturer in sociology at Columbia University and Visiting Professor of Sociology, Yale University. The book has been made available by the Commonwealth Fund.

The objectives of the Committee are defined as follows:

"To explore the possibilities and to formulate methods of maintaining and improving standards of quality in medical service, including medical research, medical education, the maintenance of health, both physical and mental, the prevention of disease, and the treatment of disease.

"To study the means of making available to larger groups of people and to the country as a whole the best known practice in preventive and curative medicine.

"To explore the possibilities and to formulate proposals of distributing these services not only to a larger number but also at a lower per capita cost than the present system permits."

The author traces in broad perspectives the social, economic, legal, and professional setting within which industrial medicine has matured and the development of the scientific knowledge which has given industrial physicians increased competence to cope with diseases affected by occupations. It delineates the prevailing disastrous rates of industrial disability and the limited extent of preventive services in industry. Recent developments in health and insurance programs are appraised and the

problems of the handicapped in industry outlined. The findings which emerge offer grave challenges to the public and to the profession, not merely to expand knowledge in the field of industrial medicine, but to apply more extensively the vast body of knowledge already available in the interests of the health and welfare of the nation.

The author has presented a somewhat sketchy but very thoughtful summation of the subject of industrial medicine. The general impression left by the book, is that both industrial management and the medical profession are not adequately coping with the problems presented in the field of industrial medicine and surgery.

C. T. OLSON.

PUBLISHED by the Commonwealth Fund, *Nursing in Commerce and Industry*<sup>2</sup> by Bethel J. McGrath is truly deserving of attention by the medical profession. Mrs. McGrath has done a most excellent job of presenting a picture of the modern nurse in commerce and industry. She is a dynamic writer and has gone into every phase of her subject with extreme thoughtfulness. Each chapter is followed by an extensive bibliography. So far as I know it is the only book published giving a comprehensive view of industrial nursing and medicine.

Although this volume has been written for the industrial nursing profession, it should be required reading for all medical students before graduation and for all physicians in any way connected with industry and commerce. It has been estimated that at the present time 90 per cent of the entire medical profession does not come in contact with industry and commerce, and except for the few who specialize in this field there is a definite lack of knowledge as to the importance of this field of medicine. This volume could very easily be used as a primer for the physician entering the field of industrial medicine.

The author, a registered nurse and a very exceptional personality, has written from the viewpoint of the nurse. One might almost conclude that industrial medicine came into being and has flowered solely through the efforts of the industrial nurse. Any contributions by the medical profession are considered of very recent origin. There may be a certain amount of casuistry on the part of the author. She states that the industrial nurse is not supposed to practice medicine, but details how the industrial nurse should set up a medical department and suggests that she be subject to the authority only of someone in the top management.

In her preface the author says: "The fact that the nursing profession, management, and medicine are not agreed as to her (industrial nurse) scope and function is not strange in so broad and diversified a field."

Because of a certain amount of confusion existing as to the placing of responsibility, the author takes a definite stand by suggesting throughout her book that the nurse can be more or less all sufficient in

<sup>1</sup>MEDICINE IN INDUSTRY. By Bernhard J. Stern, Ph D. New York: The Commonwealth Fund, 1940.

<sup>2</sup>NURSING IN COMMERCE AND INDUSTRY. By Bethel J. McGrath, R.N. New York: The Commonwealth Fund, 1945.

industrial work. There are many exceptional nurses in the industrial field and we would not argue but that some of them give far better service than do doctors. The fact that nurses are so prominent in the field of industrial medicine is due mainly to the fact that the medical profession has sadly neglected this field and that management, which is always looking for a bargain, is willing to utilize the services of a nurse in place of a medical man. American medicine is awakening to its responsibility and more and more is convincing management that all of its medical and health programs should be supervised by physicians. So far this idea has taken hold only in larger organizations, so that medical care in the majority of industries in the United States today is under the direction of nurses and part time doctors. I believe it will be definitely the attitude of the

American medical profession as time goes along that all industrial medicine should be directly under the supervision of the profession and that nurses in this field should be responsible not to someone in the top lay management but to a doctor, who in turn will report to the lay management.

There is a certain amount of danger in the attitudes created by this book in that nurses may be given the impression that they can take over tasks which legally and properly belong to the medical profession and that it is not required that they have direct medical supervision. As long as the medical profession does not bestir itself to take a more active interest in industrial medicine, Mrs. McGrath's teachings are justifiable. The responsibility for the present situation rests directly upon the medical profession.

C. T. OLSON.

## BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

**SURGICAL TREATMENT OF THE NERVOUS SYSTEM.** Supervising Editor Frederic W. Bancroft, A.B., M.D., F.A.C.S. Associate Editor Cobb Pilcher, M.D., F.A.C.S. Philadelphia, London, Montreal: J.B. Lippincott Co., 1946.

**MODERN MANAGEMENT IN CLINICAL MEDICINE.** By F. Kenneth Albrecht, M.D. Baltimore: The Williams & Wilkins Co., 1946.

**THE TRAUMATIC DEFORMITIES AND DISABILITIES OF THE UPPER EXTREMITY.** By Arthur Steindler, M.D., F.A.C.S. In collaboration with John Louis Marxer, M.D. Springfield, Illinois: Charles C Thomas, 1946.

**MOTOR DISORDERS IN NERVOUS DISEASES.** By Ernst Herz, M.D., and Tracy J. Putnam, M.D. Morningside Heights: King's Crown Press, 1946.

**ESSENTIALS OF GENERAL ANAESTHESIA.** By R. R. Macintosh, M.A., M.D., F.R.C.S., D.A., and Freda B. Bannister, M.A., M.D., D.A. 3d ed. Springfield, Illinois: Charles C Thomas, 1945.

**DOCTORS EAST DOCTORS WEST; AN AMERICAN PHYSICIAN'S LIFE IN CHINA.** By Edward H. Hume, M.D. New York: W. W. Norton & Co., 1946.

**DISEASES OF THE ADRENALS.** By Louis J. Soffer, M.D. Philadelphia: Lea & Febiger, 1946.

**EVOLUTION OF PLASTIC SURGERY.** By Maxwell Maltz, B.S., M.D., Sc.D., F.I.C.S. New York: Froben Press, 1946.

**PREOPERATIVE AND POSTOPERATIVE TREATMENT.** Edited by Lt. Col. Robert L. Mason, M.C., A.U.S., and Harold A. Zintal, M.D. 2d ed. Philadelphia and London: W.B. Saunders Co., 1946.

**SEMIOTICA DA MAMA; SEMIOTÉCNICA—DIAGNÓSTICO CLÍNICO, RADIOGRÁFICO E HISTOPATOLÓGICO—GRADUAÇÃO DE MALIGNIDADE.** By Aurélio Monteiro. Rio de Janeiro: Companhia Brasileira de Artes Gráficas, 1946.

**CORNELL CONFERENCES ON THERAPY.** Vol. 1. Edited by Harry Gold, M.D., David P. Barr, M.D., Eugene F. DuBois, M.D., McKeen Cattell, M.D., and Charles H. Wheeler, M.D. New York: The Macmillan Co., 1946.

**TREATMENT OF ARTHRITIS AND RHEUMATISM IN GENERAL PRACTICE; PARTICULARLY IN WOMEN. A DIFFERENT APPROACH TO THE PROBLEM.** By Bernard Ashner, M.D. New York: Froben Press, 1946.

**SCIENTIFIC, MEDICAL, AND TECHNICAL BOOKS; PUBLISHED IN THE UNITED STATES OF AMERICA 1930-1944: A SELECTED LIST OF TITLES IN PRINT WITH ANNOTATIONS.** Edited by R. R. Hawkins. Prepared under the direction of The National Research Council's Committee on Bibliography of American Scientific and Technical Books Washington: 1946.

**VARICOSE VEINS OF THE LOWER EXTREMITY.** By Anthony M. Barone, M.D. Chicago, Ill., 1945.

**EXERCISES IN ELECTROCARDIOGRAPHIC INTERPRETATION.** By Louis N. Katz, A.B., M.A., M.D., F.A.C.P. 2d rev. ed. Philadelphia: Lea & Febiger, 1946.

**ELECTROCARDIOGRAPHY; INCLUDING AN ATLAS OF ELECTROCARDIOGRAMS.** By Louis N. Katz, A.B., M.A., M.D., F.A.C.P. 2d rev. ed. Philadelphia: Lea & Febiger, 1946.

**A HISTORY OF MEDICINE.** By Douglas Guthrie, M.D., F.R.C.S. Ed., F.R.S.E. With an Introduction by Samuel C. Harvey, M.D., F.A.C.S. Philadelphia, London, Montreal: J.B. Lippincott Co., 1946.

**THE MANAGEMENT OF FRACTURES, DISLOCATIONS, AND SPRAINS.** By John Albert Key, B.S., M.D., and H. Earle Conwell, M.D., F.A.C.S. 4th ed. St. Louis: The C.V. Mosby Co., 1946.

**THE SURGICAL TECHNIQUE OF ABDOMINAL OPERATIONS.** By Julius L. Spivack, M.D., LL.D. 4th rev. ed. Springfield, Illinois: Charles C Thomas, 1946.

**NEW HUMAN EMBRYOLOGY.** By Bradley M. Patten. Philadelphia: The Blakiston Company, 1946.

**MEDICAL SERVICES BY GOVERNMENT: LOCAL, STATE AND FEDERAL.** By Bernhard J. Stern, Ph.D. New York: The Commonwealth Fund, 1946.

# CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

W. EDWARD GALLIE, Toronto, *President*  
IRVIN ABELL, Louisville, *President-Elect*

*Committee on Arrangements*  
HOWARD A. PATTERSON, *Chairman*; FRANK GLENN, *Secretary*

## PROGRAM FOR THE 1946 CLINICAL CONGRESS IN NEW YORK SEPTEMBER 9 TO 13, 1946

THE thirty-second annual Clinical Congress of the American College of Surgeons will be held in New York September 9 to 13 at the Waldorf-Astoria. Had war conditions not made voluntary cancellation of meetings since 1941 advisable, this would have been the thirty-sixth Congress. Practically five years will have elapsed since the Boston meeting, which will give the September Congress the significance of a quinquennial event. It is with due appreciation of this fact, and of the epochal advances in medical science achieved during the war years, that the program is being planned.

The Fellows of greater New York are working to facilitate the utilization of the clinical resources of that great medical center as background for the series of scientific sessions and hospital conferences which will be held in the headquarters hotel. Demonstrations, clinics, and clinical group conferences will be held on each of the 5 days in selected hospitals, to supplement the panel discussions, symposia, forums, and other scientific meetings at the Waldorf-Astoria in which leaders of the surgical profession from many sections of the country will take part. Visitors of outstanding reputation in the hospital field will join with local authorities in presenting a varied, timely, and stimulating program for hospital personnel.

### SIXTH NEW YORK CONGRESS

This will be the sixth time that the Clinical Congress has been held in New York. The first time was in 1912, when the old Waldorf-Astoria was the scene of the third Congress. Dr. George E. Brewer was the Chairman and Dr. Charles H. Peck the Secretary of the 1912 Committee on

Arrangements. Dr. Edward Martin of Philadelphia was then President of the Clinical Congress of Surgeons of North America. More than 2,600 physicians registered, and the lack of organization for regulating the attendance at the clinics precipitated the proposal by Dr. Franklin H. Martin at the business meeting on Friday afternoon, November 15, for the creation of the college.

At the same meeting Dr. Allen B. Kanavel presented a resolution which provided that "some system of standardization of hospital equipment and hospital work should be developed, to the end that those institutions having the highest ideals may have proper recognition before the profession, and that those of inferior equipment and standards should be stimulated to raise the quality of their work. . . ." and that "the President of the Congress be authorized to appoint a committee from the profession, delegated to carry the spirit of this resolution into effect, and report at the Clinical Congress in 1913." This resolution was adopted.

Another significant event was the appointment, during an evening session given to the consideration of cancer, held in Brooklyn, of a committee that formed the nucleus of the American Society for the Control of Cancer which was organized following the Congress of Physicians and Surgeons of North America on May 22, 1913.

Thus the plans for formation of the College and for the inauguration of activities in two fields which have always been among its major concerns, hospital betterment and cancer control, were initiated at the 1912 Clinical Congress in New York, 5 years before the Congress was amalgamated with the American College of Surgeons. Later Congresses were held in New York in 1919, 1924, 1931, and 1938.



## FIRST POSTWAR CONGRESS

The first postwar Clinical Congress will differ from the meetings for several years prior to the war in that a return will be made to the original custom of holding the Presidential Meeting on the opening evening, Monday, and the Convocation on the final evening, Friday, instead of combining them on the first night. There are several good reasons for the change among which is the likelihood of having several hundred surgeons, who have been received into fellowship *in absentia* during the years in which no Convocation was held, added to the number of initiates for the current year who will be present for the initiation ceremonies. Related to this is the need for relieving the pressure for hotel accommodations by distributing the attendance better throughout the week than would be possible if the Convocation were held on the opening night.

## COMMITTEE ON ARRANGEMENTS

A representative Committee on Arrangements has been appointed consisting of the following members:

Howard A. Patterson,  
*Chairman*  
Frank Glenn,  
*Secretary*  
Frank E. Adair  
Albert H. Aldridge  
Thomas M. Brennan  
E. Jefferson Browder  
George F. Cahill  
Henry W. Cave  
Ralph Colp  
Edward J. Donovan  
Merrill N. Foote  
John H. Garlock

Charles A. Gordon  
George J. Heuer  
J. William Hinton  
George H. Humphreys  
William F. MacFee  
John H. Mulholland  
W. Barclay Parsons  
Otto C. Pickhardt  
Thomas H. Russell  
Raymond F. Sullivan  
Howard C. Taylor, Jr.  
William Crawford White  
Philip D. Wilson

The Committee has been working diligently for several weeks on the meeting plans and the clinical program and there is every indication that this will be a most successful congress.

## CLINICAL PROGRAM

The hospitals and medical schools of greater New York are co-operating in scheduling operative and nonoperative clinics, and group clinical conferences. Visiting surgeons will have ample opportunity to attend well arranged programs of many different kinds in several of the excellent hospitals in the area. General and special demonstrations will be held such as fractures, cancer, maternal morbidity, and end-result studies; clinicopathologic and x-ray conferences; newer diagnostic and therapeutic procedures; preoperative and postoperative supportive treatment; anesthesia; and reconditioning. The newer tech-

niques and surgical procedures may be observed by those who are interested in them.

The medical schools will hold a series of exhibits demonstrating their work which will be on display in their affiliated hospitals. The program of each hospital will be arranged to cover subjects in general surgery, obstetrics and gynecology, fractures, orthopedic surgery, thoracic surgery, neurosurgery, genitourinary surgery, ophthalmology, and otolaryngology.

## PRESIDENTIAL MEETING

On Monday evening in the Grand Ballroom the Presidential Meeting will be opened with the impressive processional of the officers, regents, and honorary guests. Welcome to the assembly will be extended by the chairman of the Committee on Arrangements, Dr. Howard A. Patterson. Dr. W. Edward Gallie of Toronto, President of the College, will preside and will deliver the Presidential Address. An inaugural ceremony will be held for the incoming officers. Foreign guests will then be introduced.

A new feature to be included in the Presidential Meeting this year will be the first Martin Memorial Lecture. Dr. Edward D. Churchill of Boston has accepted the invitation to give this lecture. This lectureship was established upon motion of the Board of Regents at its midyear meeting on April 1, as a memorial to both Dr. Franklin H. Martin and Mrs. Martin. The founder of the College and of SURGERY, GYNECOLOGY AND OBSTETRICS was joined by his wife in making the College the beneficiary at their deaths of the Journal, together with its physical plant operated by the Surgical Publishing Company of Chicago, of which they were the owners. Doctor Martin died in 1935 and Mrs. Martin in 1945.

The Martin Memorial Lecture is to be given annually during the Clinical Congress. It will deal with a scientific subject of the author's own choosing, and it will supplant the former Annual Oration in Surgery.

## CONVOCATION

It is planned this year, for various reasons, to depart from the custom of recent years of holding the Presidential Meeting and the Convocation on the same evening. The Convocation is therefore scheduled for Friday evening. An Assembly of Initiates will be held prior to the Convocation on Friday in order to instruct them in the Convocation procedure and other matters.

The Convocation will open with a processional of officers, regents, and governors. The President, Dr. Irvin Abell, will preside and will make the

opening remarks, confer the honorary fellowships, and present the candidates for fellowship. Following this ceremony, a speaker to be announced later will give the Fellowship Address.

#### SCIENTIFIC SESSIONS

Eminent surgeons and specialists, recognized as authorities in their fields, will address the scientific sessions, to be held on Tuesday, Wednesday, and Thursday evenings. These will be conducted as symposia, and the subjects for the three nights will be as follows: Tuesday, "Care of the Patient Before and After Operation"; Wednesday, "Venous Thrombosis and Prevention of Pulmonary Embolism"; and Thursday, "Antibiotic and Chemotherapeutic Agents in Surgery." The annual Fracture Oration will be included in the Wednesday evening program.

Single major panel discussions will be held every afternoon, from Monday through Thursday, as follows:

Monday, 1:30 to 3:00—Rehabilitation of the Surgical Patient and Early Ambulation

Monday, 3:30 to 5:00—The Treatment of Cancer of the Large Bowel

Tuesday, 1:30 to 3:00—Thiouracil in Thyroid Disease

Tuesday, 3:30 to 5:00—Recent Trends in the Management of Carcinoma of the Cervix

Wednesday, 1:30 to 3:00—Anesthesia

Wednesday, 3:30 to 5:00—Protein Metabolism in the Surgical Patient

Thursday, 1:30 to 5:00—Spinal Cord Injuries

Friday, 1:30 to 3:00—Surgery of the Stomach

Friday, 3:30 to 5:00—Surgery of the Vascular System

A symposium on fractures and other traumas will be held on Tuesday afternoon, and a symposium on cancer on Wednesday, from 2:00 to 4:00 o'clock.

Concurrent panel discussions are also planned for Friday afternoon. Subjects to be discussed are plastic surgery, thoracic surgery, urology, neurological surgery, orthopedics, and obstetrics.

#### OPHTHALMOLOGY AND OTORHINOLARYNGOLOGY SESSIONS

Ophthalmology panel discussions will be held Tuesday, Wednesday, and Thursday mornings at 11:00 o'clock on, respectively, "Retinal Detachment," "Glaucoma," and "Keratoplasty." On Tuesday evening at 8:00 o'clock there will be a symposium on "Orbital Reconstruction Including Prosthesis." On Thursday evening a scientific session is planned with the following as the subjects: "Recent Advances in Ophthalmology";

"Medical Treatment of Glaucoma"; and "Visual Disturbances Associated with Head Injuries."

Otorhinolaryngology panel discussions will be held Tuesday, Wednesday, and Thursday mornings at 11:00 o'clock on, respectively, "Treatment of Meniere's Disease," "Osteomyelitis of the Skull," and "Rehabilitation of War Deafness." On Tuesday evening at 8:00 o'clock there will be a symposium on "Treatment of Deafness" and on Thursday evening a symposium on "Surgery of the Nasal Accessory Sinuses."

Of interest to ophthalmologists, otorhinolaryngologists, and other surgeons will be a symposium to be held on Wednesday evening at 8:00 o'clock on "Plastic Surgery of the Head and Neck."

#### FORUMS ON FUNDAMENTAL SURGICAL PROBLEMS

The Forums on Fundamental Surgical Problems will be conducted on Tuesday, Wednesday, Thursday, and Friday mornings. Included in them will be brief reports of original clinical and experimental observations relating to the broad aspects of surgery and the surgical specialties. No prepared discussions of the reports are planned, but questions and comments will be invited. Especially keen interest is expected in these sessions this year because of the accumulation of the results of 5 years of work since the last Clinical Congress. Dr. Owen H. Wangenstein of Minneapolis, chairman of the committee which is planning the program, is working toward representation of as many as possible of the various university departments of surgery in this presentation of clinical and experimental research work.

The enlistment of the interest of young men who are doing original work, through the forums, is one of the most beneficial results of these sessions which are now considered to be an indispensable feature of every Clinical Congress.

#### HOSPITAL CONFERENCE

Dr. W. Edward Gallie, President of the College, will address the opening session of the twenty-fifth annual Hospital Standardization Conference on Monday morning at 10:00 o'clock in the Grand Ballroom, and will preside at the meeting, which will be attended by surgeons and hospital representatives. Following Dr. Gallie's résumé of the Hospital Standardization program of the College, including plans for the future, there will be reports on the progress of the 1946 Hospital Standardization survey, final results of which, including the Approved Lists of hospitals, cancer clinics, and approved hospitals for graduate training in surgery, will be announced at the end

of the year, instead of at the Clinical Congress as was the practice in former years.

The remainder of the Monday morning session will be devoted to talks by medical and hospital authorities on advances in medicine and surgery as they affect the postwar hospital, with particular consideration of their relation to the Hospital Standardization program.

The afternoon conference on Monday will be concentrated upon current problems and the outlook for the future in nursing service. The Tuesday morning conference will have as its main subject personnel management, and the Tuesday afternoon session will be centered around personnel problems in specific fields, such as dietary, laboratory, medical records, medical social service, x-ray, physical and occupational therapy, and other professional and semi-professional services. The discussions will emphasize the importance of scientific management techniques in assuring high quality service from personnel.

The Wednesday morning conference will have as its main theme the importance of assuring high standards of care to the community and all patients through providing in the general hospital facilities for all types of illness. The subject will be discussed from the standpoint of psychiatric, tuberculous, cancer, chronically ill, and convalescent patients. The Wednesday afternoon conference will center mainly around discussion of ways of improving co-operation between general hospitals and special hospitals in the care of all types of special patients.

The Thursday morning conference will revolve around the physical plant of the hospital and the importance of improvement and modernization in raising standards of care of the patient. New mechanical and technical developments will be presented. The afternoon conference will be devoted to the hospital as the health center of the community, with consideration of the effects of this concept upon hospital public relations and upon the progress of preventive medicine and public health.

An evening conference will be held at 7:00 o'clock on Tuesday. This will be devoted to discussion of the responsibilities of trustees, and members of governing boards will be especially invited to attend and to participate. A conference will be held on Wednesday evening also. This will be a round table conference on responsibilities of hospital administrators, and the preparation which is necessary to enable them to cope successfully with the wide range of administrative problems. The discussion of these problems will interest all hospital personnel.

#### ANNUAL MEETING OF FELLOWS

The annual meeting of the Governors and Fellows will be held on Thursday afternoon at 1:45. There will be election of officers and governors. The annual meeting affords the Fellows of the College an opportunity to hear reports of officials on the work of the organization, and to learn how it has not only raised the professional and ethical standards of surgery, but has also promoted good hospitalization and general improvement in the practice of medicine in the United States and Canada. Each Fellow has a personal part in this work and may extend the influence of the College materially in his local community. Hospital Standardization alone offers him unlimited opportunity to provide better medical care for his patients in the hospital in which he works through continuous progress in applying the principles of the Minimum Standard which insure the best care of the patient.

Every Fellow will want to attend this important meeting, at which reports will be presented on financial affairs; Hospital Standardization; Graduate Training in Surgery; Medical Motion Pictures; Public Relations; Library and Literary Research; the work of the state and provincial credentials committees, committees on applicants, and the Committee on History Reviews; Sectional Meetings, 1946; and the Department of Clinical Research, including cancer clinics, medical service in industry, the Committee on Cancer, and the Committee on Fractures and other Traumas. Dr. Abell will report on administration of the College, staff changes, and retirements, and Dr. Arthur W. Allen, Vice-Chairman of the Board of Regents will discuss "Fellowships, Obligations and Opportunities."

#### STATE AND PROVINCIAL EXECUTIVE, CREDENTIALS AND JUDICIARY COMMITTEES

On Wednesday morning from 9:00 to 12:00 o'clock the State and Provincial Executive, Credentials, and Judiciary committees will meet to discuss their respective activities.

#### MEDICAL MOTION PICTURES

The latest available films showing surgical procedures and related subjects will be shown in the medical motion picture exhibits which will be held daily. These are a much appreciated feature of the Clinical Congress. Despite the decrease in production of such films during the war period, a surprising number of new pictures are being received by the College for review.

The schedule will be so arranged as not to conflict with either the clinical program at the

hospitals or the scientific sessions. Both sound and silent, standard and color films will be shown, all of which have been approved by the Committee on Medical Motion Pictures.

#### TECHNICAL AND SCIENTIFIC EXHIBITION

The technical exhibit, together with the registration and clinic ticket bureaus, will be located in the Basilidon Room, Jade Room, and Astor Gallery, all on the third floor of the hotel. Leading manufacturers of surgical instruments, x-ray apparatus, sterilizers, operating room lights, ligatures, dressings, hospital apparatus and supplies of all kinds, pharmaceuticals, and publishers of medical books will be represented in the exhibition. The technical exhibits will demonstrate many of the newer features learned from our experience in the war.

#### ADVANCE REGISTRATION

The hospitals and medical schools of New York afford accommodations for a large number of visiting surgeons. However, in order to insure against overcrowding, attendance at the Congress will be limited to the number that can be comfortably accommodated at the meetings and also by accommodations in the hotels. It is therefore expected that surgeons who wish to attend the Congress will register in advance.

The members of the Board of Regents regret that conditions beyond their control will not permit unpaid registration at the 1946 Clinical Congress as had previously been indicated. At their midyear meeting on April 1, 1946, they voted to restore the registration fee of \$5.00 for Fellows and for endorsed Junior Candidates. Non-fellows attending as invited guests of the College will pay a fee of \$10.00. No fee will be required of initiates in the classes of 1942 through 1946.

To each surgeon who registers in advance a formal receipt will be issued. This is to be exchanged for a general admission card upon his registration at headquarters during the Congress. This card is not transferable and must be presented in order to obtain clinic tickets and admission to scientific sessions.

#### HOTEL RESERVATIONS

With the present congested hotel conditions, Fellows are urged to make early reservation at a hotel of their choice in the New York area. Should difficulty be experienced in obtaining accommodations, the College will upon request forward a special form "Application for Hotel Accommodations" which may be sent to the Housing Bureau of the American College of Sur-

geons, Room 1536, 233 Broadway, New York 7. The Committee on Arrangements feels that the housing situation will remain acute in New York for some time to come and in consequence recommends that all Fellows who can do so, make their own arrangements for lodgings while there. The New York Convention Bureau is co-operating by reserving as many hotel rooms as can be obtained for Clinical Congress registrants.

Following is a list of hotels:

	Minimum Rates with Bath	
	Single	Double
Allerton House, 143 East 39th Street	\$2.75	
Allerton House for Women, 130 East 57th Street	3.00	
Ambassador, Park Avenue & 51st Street	6.00	
Astor, Broadway & 44th Street	3.50	\$4.00
Barbizon (Women) Lexington Avenue & 63rd Street	3.50	
Barclay, 11 East 48th Street	6.00	8.00
Belmont Plaza, Lexington Avenue & 49th Street	4.00	6.00
Beverly, Lexington Avenue & 50th Street	5.00	
Biltmore, Madison Avenue & 43rd Street	5.50	7.50
Bristol, 129 West 48th Street	2.50	3.50
Capitol, 51st Street & 8th Avenue	3.00	4.50
Carlyle, Madison Avenue at 76th Street	6.00	
Chesterfield, 130 West 49th Street	2.50	4.00
Commodore, Lexington Avenue & 42nd Street	3.50	5.50
Concourse Plaza, Grand Concourse & 161st Street	3.50	5.50
Cornish Arms, 311 West 23rd Street	2.25	4.00
Delmonico, 502 Park Avenue	6.00	8.00
Essex House, 160 Central Park South	6.00	8.00
Fifth Avenue Hotel, 24 Fifth Avenue (9th Street)	4.00	6.00
Governor Clinton, 31st Street & 7th Avenue	3.30	4.40
Henry Hudson, 353 West 57th Street	2.50	3.50
Kenmore Hall, 145 East 23rd Street	2.00	3.50
Lexington, 48th Street & Lexington Avenue	4.00	6.00
Luxor Baths Hotel, 121 West 46th Street	2.25	
McAlpin, Broadway & 34th Street	3.30	4.95
Martiniague, Broadway at 32nd Street	2.75	3.85
Midston House, 22 East 36th Street	3.50	4.00
New Weston, Madison Avenue & 50th Street	4.00	7.00
New Yorker, 34th Street & 8th Avenue	3.85	5.50
Paramount, 46th Street, West of Broadway	3.00	5.00
Park Central, 7th Avenue & 55th Street	4.00	6.00
Parkside, 18 Gramercy Park South	2.75	
Pennsylvania, 7th Avenue & 33rd Street	3.85	5.50
Piccadilly, 227 West 45th Street	3.00	5.00
Plymouth, 143 West 49th Street	2.50	3.50
President, 234 West 48th Street	2.50	4.00
Prince George, 14 East 28th Street	2.50	4.00
Roosevelt, Madison Avenue & 45th Street	4.00	6.50
Shelton, 49th Street & Lexington Avenue	3.50	5.00
Taft, 7th Avenue & 50th Street	3.00	5.00
Times Square, 43rd Street & 8th Avenue	2.25	4.00
Tudor, 304 East 42nd Street	2.50	
Victoria, 7th Avenue & 51st Street	3.00	4.50
Waldorf-Astoria, 50th Street & Park Avenue	7.00	
Warwick, 54th Street at Sixth Avenue	5.00	
Wellington, 7th Avenue & 55th Street	3.00	4.50
Woodstock, 127 West 43rd Street	3.00	5.00

## CLINICAL CONGRESS PROGRAM IN BRIEF

*Monday, September 9*

- 10:00 General Assembly for Surgeons and Hospital Representatives, Grand Ballroom  
 1:30-3:00 Panel Discussion, Empire Room  
 2:00 Clinics, Demonstrations and Clinical Group Conferences, Selected local hospitals  
 2:00 Hospital Conference, Sert Room  
 1:00 Surgical Film Exhibition (General), Grand Ballroom  
 3:00-5:00 Panel Discussion, Empire Room  
 8:00 Presidential Meeting, Grand Ballroom

*Tuesday, September 10*

- 9:00 Clinics, Demonstrations and Clinical Group Conferences, Selected local hospitals  
 10:00 Hospital Conference, Sert Room  
 9:30 Surgical Film Exhibition (Eye, Ear, Nose and Throat), Jensen Suite  
 9:30-12:00 Forum on Fundamental Surgical Problems, Grand Ballroom  
 10:00 Surgical Film Exhibition (General), Empire Room  
 11:00 Panel Discussions  
     Ophthalmology  
     Otorhinolaryngology  
 1:30-3:00 Panel Discussion, Grand Ballroom  
 2:00 Clinics, Demonstrations and Clinical Group Conferences, Selected local hospitals  
 2:00 Hospital Conference, Sert Room  
 2:00 Symposium on Fractures and Other Traumas  
 2:00 Surgical Film Exhibition (General), Empire Room  
 3:30-5:00 Panel Discussion, Grand Ballroom  
 7:00 Surgical Film Exhibition (Eye, Ear, Nose and Throat), Empire Room  
 7:00 Hospital Conference—Trustees, Sert Room  
 8:00 Scientific Session, General Surgery, Grand Ballroom  
 8:00 Scientific Session, Panel Discussion Ophthalmology, Jensen Suite  
 8:00 Scientific Session, Otorhinolaryngology, Le Perroquet Suite

*Wednesday, September 11*

- 8:00 Meeting of Cancer Committee, Carpenter Foyer and Dining Room  
 9:00 Clinics, Demonstrations and Clinical Group Conferences, Selected Local Hospitals  
 9:30 Hospital Conference, Sert Room  
 9:30 Surgical Film Exhibition (Eye, Ear, Nose and Throat), Empire Room  
 9:30-12:00 Forum on Fundamental Surgical Problems, Grand Ballroom  
 10:00 Surgical Film Exhibition (General)  
     State and Provincial Committees:  
     Judiciary Committees  
     Executive Committees  
     Credentials Committees and Committees on Applicants } Empire Room  
 11:00 Panel Discussions  
     Ophthalmology  
     Otorhinolaryngology  
 12:00 Meeting of Board of Governors, Jensen Suite  
 1:30-3:00 Panel Discussion, Grand Ballroom  
 2:00 Clinics, Demonstrations and Clinical Group Conferences, Selected local hospitals

- 2:00 Symposium on Cancer, Empire Room  
 2:00 Surgical Film Exhibition (General)  
 2:30 Hospital Conference, Sert Room  
 3:30-5:00 Panel Discussion, Grand Ballroom  
 6:00 Vandyck Reunion Dinner, Le Perroquet Suite  
 7:00 Surgical Film Exhibition (Eye, Ear, Nose and Throat), Empire Room  
 7:30 Hospital Conference, Sert Room  
 8:00 Scientific Session, General Surgery, Grand Ballroom  
 8:00 Scientific Session (Eye, Ear, Nose and Throat), Empire Room

*Thursday, September 12*

- 9:00 Clinics, Demonstrations and Clinical Group Conferences, Selected local hospitals  
 9:30 Hospital Conference, Sert Room  
 9:30 Surgical Film Exhibition (Eye, Ear, Nose and Throat), Empire Room  
 9:30-12:00 Forum on Fundamental Surgical Problems, Grand Ballroom  
 10:00 Surgical Film Exhibition (General), Empire Room  
 11:00 Panel Discussions  
     Ophthalmology  
     Otorhinolaryngology  
 1:30 Adjourned Meeting, Governors, Grand Ballroom  
 1:45 Annual Meeting, Fellows, Grand Ballroom  
 2:00 Clinics, Demonstrations and Clinical Group Conferences, Selected local hospitals  
 2:00 Hospital Conference, Sert Room  
 3:00 Panel Discussion—Graduate Training in Surgery, Jensen Suite  
 3:30-5:00 Panel Discussion, Grand Ballroom  
 3:30 Surgical Film Exhibition (General), Empire Room  
 3:30 National and Regional Fracture Committees, Le Perroquet Suite  
 4:00 Committee on the Library, Room 4-J  
 7:00 Surgical Film Exhibition (Eye, Ear, Nose and Throat), Empire Room  
 8:00 Scientific Session, General Surgery, Grand Ballroom  
 8:00 Scientific Session, Ophthalmology, Empire Room  
 8:00 Scientific Session, Otorhinolaryngology, Sert Room

*Friday, September 13*

- 9:00 Clinics, Demonstrations and Clinical Group Conferences, Selected local hospitals  
 9:30 Surgical Film Exhibition (Eye, Ear, Nose and Throat), Empire Room  
 9:30-12:00 Forum on Fundamental Surgical Problems, Grand Ballroom  
 10:00 Surgical Film Exhibition (General), Empire Room  
 2:00 Clinics, Demonstrations and Clinical Group Conferences, Selected local hospitals  
 2:00-4:00 Panel Discussions  
     Obstetrics, Sert Room  
     Plastic Surgery, 4-U Blue Room  
     Neurological Surgery, Assembly Room M-N  
     Thoracic Surgery, Jensen Suite  
     Urology, Le Perroquet Suite  
     Orthopedic Surgery, Carpenter Foyer and Dining Room  
 2:00 Surgical Film Exhibition (General), Empire Room  
 8:00 Convocation, Grand Ballroom

July, 1946

**SURGERY**  
**GYNECOLOGY AND OBSTETRICS**  
*Supplement*

**INTERNATIONAL ABSTRACTS**  
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# INTERNATIONAL ABSTRACTS OF SURGERY

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## COLLECTIVE REVIEW

### A SUMMARY OF THE SURGICAL ASPECTS OF CERTAIN SULFONAMIDES AND ANTIBIOTIC AGENTS

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WITH the report of Domagk in 1935 that a certain dye would protect mice against lethal doses of streptococci, and the subsequent proof by Trefouel and others (7, 11, 27, 68) that this effect was due to hydrolysis of the dye within the body to sulfanilamide, an era of chemotherapeutic development was initiated which has been startling in the complexity and variety of chemotherapeutic agents which have become available within a short span of years. Of the many classes of compounds which have become of major therapeutic importance, the sulfonamides and that group of antibacterial and antifungal substances derived from living sources, known as the antibiotics, are especially important in surgical therapy.

The chemical structure of the sulfonamides is essentially simple and is based fundamentally upon the benzene ring. When an amino ( $-NH_2$ ) group is substituted for one of the hydrogen atoms of this ring, aniline is formed; the substitution of a sulfonyl group ( $-SO_2OH$ ) for another hydrogen of the benzene ring produces sulfanilic acid. If the ( $-OH$ ) group then is replaced by an amino ( $-NH_2$ ) group, the resulting compound is para-aminobenzenesulfonamide, or sulfanilamide.

With sulfanilamide as a starting point, one of the hydrogen atoms of the ( $-SO_2NH_2$ ) group may

be replaced by any one of a number of radicals and the resulting analogues of sulfanilamide will have different antibacterial, pharmacologic, and physical characteristics; these of course have a selective bearing upon their medical usage.

An important chemical reaction which affects the therapeutic usefulness of the sulfonamides occurs within the body, and is known as acetylation. This process occurs principally in the liver, and consists of the substitution of an acetyl ( $-COCH_3$ ) group for one of the hydrogens of the amino group attached directly to the benzene ring. This acetylated form per se generally appears to be therapeutically inactive in the body, but has an important bearing upon the pharmacologic properties and toxicity of the drug. Sulfapyridine, for instance, is conjugated to form the acetyl derivative to a much higher degree than either sulfanilamide, sulfathiazole, or sulfadiazine. Also in the case of sulfapyridine and certain others of the sulfonamides, the acetylated form is more insoluble than the free form. There is, therefore, a tendency for the conjugated compound to form a precipitate of crystals in the urine which may attain sufficient size to cause an actual occlusion of the kidney, pelvis, or ureter. However, in the case of still other sulfonamides, for instance, sulfadiazine, the acetylated form is more soluble in urine than is the free form.

Of the many thousands of compounds which have been synthesized on the basis of these broad chemical principles, a relatively few are of practical importance at the present time. These possess a considerable degree of bacterial specificity, and it therefore is important that the selection of a particular drug for therapeutic purposes be made

A portion of the material dealing with antibiotics was read with additions, before the Scientific Section of the Proprietary Association of America, New York, N. Y., December 5, 1945, by invitation.

Assistant Surgeon, New York Post-Graduate Medical School and Hospital.

The accumulation of much of the data reported herein with respect to the antibacterial and sensitizing properties of tyrothricin was made possible by a grant from the Johnson and Johnson Research Foundation.

on the basis of precise bacteriologic information. Frequently the nature of the etiologic agent may be apparent from the clinical aspects of the disease; when this is not so, diagnostic cultural procedures should be undertaken whenever possible, and the susceptibility of the causative organism to the contemplated therapeutic agent determined for maintenance of adequate dosages.

In addition to the bacterial specificity of the drug, one must consider the potential toxicity of the compound to the human organism under the pertaining pathophysiological conditions. The sulfonamides, in general, are relatively toxic—some more so than others—but all may cause reactions. From the standpoint of toxicity, therefore, certain selections may be made; the selected drug must be compatible with the bacteriologic circumstances, or its administration would prove ineffective. Other important factors influencing selection are the rapidity of absorption and excretion of the drug, and the degree of acetylation, both of which have a primary bearing upon the dosage and frequency of administration.

There are few contraindications to the use of other necessary drugs concomitant with the sulfonamides. It was thought at first that the administration of saline laxatives and sulfanilamide tended to produce sulfhemoglobinuria or methemoglobinuria, but there seems to be little supporting evidence for this belief (46). Nor does there seem to be any reason for regulating the diet simply because a sulfonamide is being given, since no support can be found for the impression, in the instance, that the presence of eggs in the diet facilitates the production of sulfhemoglobinuria.

Patients who are receiving sulfonamides should not be subjected to ultraviolet therapy, or exposed to strong sunlight. There appears to be no contraindication to the use of inhalation anesthesia in patients receiving the sulfonamides, nor do these drugs appear to affect adversely the patient's response to surgical procedures.

It has been our experience that surgical patients tolerate the administration of sulfonamides with fewer toxic manifestations if an adequate vitamin C intake is maintained. This is true particularly in patients receiving general anesthetics, as in inhalation anesthesia may produce a serious vitamin C deficiency (Beyer, 6).

The sulfonamides commonly used for therapeutic purposes may be divided into those which are readily absorbed from the gastrointestinal tract, such as sulfanilamide, sulfathiazole, sulfadiazine, and sulfamerazine, and those which are poorly absorbed and whose action is largely limited to the intestinal tract, such as sulfaguanidine (actually,

as shown by Firor and Poth, and by Streicher [66], considerable amounts of this compound are absorbed at therapeutic dosage levels), sulfasuxidine (succinylsulfathiazole), and sulfathalidine (phthalylsulfathiazole).

#### SULFANILAMIDE

Sulfanilamide (para-aminobenzene sulfonamide), the first sulfonamide to attain wide use in this country, is effective by mouth and is readily absorbed from the gastrointestinal tract, significant blood levels being attained an hour following a single large dose. It diffuses rapidly into all of the body tissues and fluids, and during parturition the concentrations of the drug in the maternal and fetal circulations are equivalent. Between 10 and 15 per cent of the circulating drug is in the acetylated form; over 90 per cent, of which from 25 to 50 per cent is conjugated, is excreted in the urine. It is important to realize that the amount of drug excreted is directly proportional to the amount of urine secreted; the dosage and administration of fluids may be so adjusted that a balance is maintained easily by frequent administration of the drug. The compound is almost entirely excreted from the body within 48 hours following withdrawal.

Sulfanilamide is particularly effective against beta hemolytic streptococcal infections, but, because of lower toxicity, sulfadiazine may be preferable. In cases of streptococcal bacteremia, sulfanilamide has markedly reduced the morbidity and mortality when given in doses sufficient to produce a blood level of from 10 to 15 mgm. per 100 c.c.

Streptococcal infection of the peritoneum is most common in young children. The infection may not infrequently appear to be endogenous in origin, but is more commonly seen as the main component of a mixed infection following some surgical catastrophe, such as a ruptured appendix. Two therapeutic approaches are desirable. Sufficient sulfanilamide should be given by mouth to maintain a blood level of at least 10 mgm. per 100 c.c., and, when surgical intervention is carried out, the topical application of sulfanilamide powder to the involved peritoneal site may prove of value in many cases. All other recognized therapeutic measures should, of course, be carried out concomitantly.

In the treatment of mastoiditis the sulfonamides must be used with care, since a spreading lesion may easily be masked. When actual suppuration has occurred, immediate recourse should be made to surgical intervention. Nevertheless, it would appear that the general use of the sul-

fonamides in the treatment of the above mentioned conditions has greatly lessened the incidence of surgical mastoiditis.

Streptococcal pneumonia and empyema respond favorably to this drug, but sulfadiazine has been shown to be highly effective, and is probably to be preferred because of its lower toxicity.

In cellulitis and lymphangitis, which are usually due to streptococcal invasion of the tissues, sulfanilamide is effective; but again it must be pointed out that sulfadiazine and sulfamerazine appear to be at least as effective and are less toxic.

Good results have been reported in the treatment of streptococcal osteomyelitis by the oral and local use of sulfanilamide. High blood levels should be maintained for 2 weeks or longer, and all local suppurations should be incised and drained.

The effectiveness of sulfanilamide against the extremely heterogeneous group of infections caused by alpha hemolytic streptococci is questionable. Although Spink has shown that the drug is bacteriostatic for some strains. One is, therefore, justified in administering sulfanilamide for a reasonable period of time, but, if no improvement occurs, penicillin should be tried.

Sulfanilamide has little effect against anaerobic streptococcal infections when administered orally. It has been observed, however, that the local bacteriostatic effect of sulfanilamide may be potentiated by combination with zinc peroxide. This form of therapy, in conjunction with adequate surgical procedures, is frequently effective; if not, penicillin should be used, possibly in combination with either sulfanilamide or sulfadiazine.

We (2) and others (30, 31, 33, 58, 64, 67) have reported good results with sulfanilamide in the acute or early phases of lymphogranuloma venereum, but sulfathiazole also has proved effective. However, sulfadiazine gives promise of being more satisfactory than either drug because of lower toxicity.

When sulfanilamide is to be used in the treatment of severe infections, it is given in an initial dose of 0.10 gm. per kilogram of body weight (46). This is followed by a total daily dosage of 0.10 gm. per kilogram of body weight, divided into 6 doses, and administered every 4 hours until the temperature has remained normal for at least 7 days. In hemolytic streptococcal otitis media, mastoiditis, or osteomyelitis, the drug should be continued in somewhat smaller doses for at least 10 days after a clinical cure has been obtained. It is considered that a blood level of from 10 to 15 mgm. per 100 c.c. is adequate in most cases. In order to attain this it is very rarely necessary to exceed a total

dose of 13 gm. during the first 24 hours; as a rule, 10 gm. suffice in the average adult.

Sulfanilamide should be given by mouth whenever possible, but, if necessary, it can be freshly prepared, 1 per cent in saline solution, and given subcutaneously. One-half of the total calculated 24 hour dose is given initially, the remainder being divided between 2 subsequent doses given at 8 hour intervals.

# SULFAPYRIDINE

Sulfapyridine (2-[p-aminobenzenesulfonamido]-pyridine) diffuses readily into all bodily tissues and fluids, and the concentration found in the spinal fluid is approximately 65 per cent of that in the blood. A considerably higher percentage of the drug is acetylated within the body than is the case with sulfanilamide, and may amount in some cases to as much as from 60 to 75 per cent of the total circulating drug.

Sulfapyridine is excreted, largely in the acetylated form, somewhat more slowly than is sulfanilamide by the kidneys. Acetylated sulfapyridine is less soluble than free sulfapyridine; and when present in sufficiently high concentration, there is a tendency for the compound to form crystals in the urine, which may result in hematuria, renal colic, or obstruction.

In addition to its specific bacteriostatic action, sulfapyridine exerts a rather marked antipyretic action, quite apart from that which might be expected from alleviation of the specific infectious condition for which the drug is being given. This may be quite confusing at times, and should not be the cause of overoptimism when this drug is used in the treatment of a severely ill patient.

Because of the availability of less toxic and more effective compounds, we have abandoned completely the use of sulfapyridine except in cases of anthrax. In this condition sulfapyridine appears somewhat more effective than other sulfonamides when given in doses of 4 gm. initially, followed by 1 gm. every 4 to 6 hours. However, it is important to be alert for toxic manifestations, especially those involving the urinary tract.

# SULFATHIAZOLE

Sulfathiazole (2-[p-aminobenzenesulfonamido]-thiazole) is about one-tenth as soluble as sulfanilamide, but is rapidly absorbed from the intestinal tract when administered by mouth, the maximum concentrations being reached in from 3 to 6 hours. However, it is excreted very rapidly by the kidneys unless renal function is impaired, so that the maintenance of adequate blood levels is sometimes difficult. The urinary complications



encountered following the administration of sulfathiazole include gross and microscopic hematuria, azotemia, and anuria. These effects may be due to the formation of acetyl sulfathiazole crystals and calculi in the renal tubules, pelvis, or ureters, but in some patients seem to be the result of a direct toxic effect of the drug on the renal epithelium. It is therefore especially important, when this drug is used, to maintain a urinary output of at least 1,000 c.c. per day.

Sulfathiazole is useful in the treatment of staphylococcal infections and some infections of the urinary tract due to the *Escherichia coli*.

Since sulfathiazole is only slightly soluble, it must be administered orally. However, when oral administration is impossible, or satisfactory concentrations of the drug cannot be maintained by this route, the sodium salt may be given intravenously. When so given, the dosage is based on 0.06 gm. per kilogram of body weight of the sodium salt made up in a 5 per cent solution of sterile, freshly distilled water. Subsequent doses are based upon 0.03 gm. per kilogram of body weight given at 6 hour intervals.

In the treatment of large boils or carbuncles, the initial dose for adults should be 4.0 gm., followed by 1.0 gm. every 4 hours, day and night, for from 5 to 7 days. In diffuse staphylococcal cellulitis, lymphangitis, or acute osteomyelitis, 4.0 gm. should be given as an initial dose, to be followed by doses of 1.5 gm. every 4 hours, day and night, as long as evidence of a spreading infection continues. Then the dose is reduced to 1.0 gm. every 4 hours, day and night, and continued as indicated. In staphylococcal bacteremia the initial dose for adults should be 4.0 gm. followed by 1.5 gm. every 4 hours, day and night, until the temperature has been normal for 48 hours. Then the dose may be reduced to 1.0 gm. every 4 hours, day and night, for 14 days, at which time the dose is further reduced to 0.5 gm. every 4 hours, day and night, and continued for a minimum of 14 days. In severe staphylococcal infections in children, the initial dose should be calculated on the basis of 0.2 gm. per kilogram of body weight (up to 20 kgm. of weight). The total daily dose is calculated on the same basis, and should be divided into 6 parts, given at 4 hour intervals, day and night, until the temperature has been normal for 48 hours. Then each dose may be reduced by one-third and treatment continued at this level for 14 days, at which time the current dose may be reduced by one-half.

In staphylococcal bacteremia there is a great possibility that a relapse will occur unless prolonged treatment with the drug is employed.

In chronic staphylococcal infections, such as osteomyelitis, it is to be remembered that surgical measures, both supportive and operative, must be used whenever indicated, and in our opinion both sulfadiazine and penicillin are more useful chemotherapeutic agents in this condition than is sulfathiazole. Surgical drainage of purulent foci must be effected, because while drugs may halt the invasive manifestations of staphylococcal infection, no drug by itself will cure areas of localized infection, and a flare-up in such areas is likely to occur if they are not properly drained.

#### SULFADIAZINE

Sulfadiazine (2-(p-aminobenzenesulfonamido)-pyrimidine) is considerably less toxic than sulfathiazole and, although it is readily absorbed from the gastrointestinal tract (51), it is excreted slowly. Studies of the distribution of the drug within the body have shown that it is present in the peritoneal and pleural fluids in approximately the concentration found in the blood; in the cerebrospinal fluid the concentration is approximately 50 per cent of the blood concentration.

This compound is highly effective in the treatment of pneumococcal, streptococcal, staphylococcal, and meningococcal infections, erysipelas, acute infections of the urinary tract, especially those due to susceptible strains of the *Escherichia coli*, and acute gonorrheal urethritis and arthritis (24). Chronic urinary tract infections do not respond readily to sulfadiazine; especially stubborn are chronic *Escherichia coli* and *Bacillus proteus* infections. Sulfadiazine causes considerably less nausea and other side reactions than does sulfathiazole. The precipitation of acetylsulfadiazine crystals in the urinary tract may be largely avoided by the administration of sufficient alkali by mouth to maintain a slightly alkaline urine. It has been stated (29) that the amounts of sulfadiazine and acetylsulfadiazine dissolved in normal urine at pH 7.5 are twenty times greater than at pH 5.0. The simplest way to test urine clinically for alkalinity is by means of nitrazine paper. To produce consistently alkaline urine requires the daily administration of from 12 to 24 gm. of sodium bicarbonate (49, 60). The administration of sodium bicarbonate in amounts equivalent to the dosage of sulfadiazine is said to reduce the incidence of crystalluria by 60 per cent (49). We have found that an average dose of 1 gm. of sodium bicarbonate every 4 hours<sup>1</sup> satisfactorily reduces the danger of urinary complications, although there is some evidence that both sulfa-

<sup>1</sup>The sodium bicarbonate is routinely given in doses equivalent to the amount of sulfadiazine.

diazine and sulfamerazine may exert a direct nephrotoxic effect, quite aside from the question of alkalization (1). Ohnysty and Wolfson have suggested the daily administration of 12 gm. of potassium bicarbonate on the excellent basis of avoiding the complications of sodium retention in patients potentially subject to cardiac decompensation, and as a means of increasing the urinary output. Rohr and Christopher (60) have found that immediate alkalization may be obtained in surgical patients unable to take oral medication by the daily intravenous administration of 1,000 c.c. of one-sixth molar sodium *r*-lactate.

The administration of sulfadiazine should be directed toward the maintenance of a blood concentration of 10 mgm. per 100 c.c., and the attainment of this level as rapidly as possible (63). The initial dose is calculated on the basis of 0.10 gm. of sulfadiazine per kilogram of body weight. Thereafter, 1 gm. of the drug is given every 4 hours until the temperature has been normal for 3 days.

Circumstances frequently arise which make it impossible to administer a sufficient amount of the drug to severely ill patients by mouth to raise the blood concentration to a therapeutically desirable level. In these instances the sodium salt is administered intravenously in a concentration of 5 per cent in sterile distilled water; because of the marked alkalinity of this solution, care must be taken not to allow any of the material to leak into the perivascular tissues.

In the combined parenteral and oral method of therapy the initial dose of sodium sulfadiazine is based on 0.60 gm. per kilogram of body weight. The maintenance dose of 1 gm. of sulfadiazine every 4 hours then is given orally.

If it is necessary to resort to parenteral therapy alone, the initial dose is the same as for the combined type, but the maintenance dose is calculated on the basis of 0.05 gm. per kilogram of body weight. This dose is administered intravenously every 12 hours. Frequent determinations of the concentration in the blood should be made. It is inadvisable to exceed a blood concentration of 20 mgm. per 100 c.c., and a change should be made to the oral route as early as possible.

In infants and children the initial doses for both oral and parenteral administration are calculated in the manner already outlined. This is true also of the maintenance dose of sodium sulfadiazine. The total daily dose of sulfadiazine is calculated on the basis of 0.10 gm. per kilogram of body weight and is divided into 6 parts given at 4 hour intervals until the temperature has been normal for 48 hours.

For the treatment of mild and moderately severe hemolytic streptococcal infections, the initial dose of sulfadiazine is based on 0.05 gm. per kilogram of body weight. The total daily dose consists of 0.10 gm. per kilogram of body weight divided into 6 doses and given every 4 hours until the temperature has been normal for 5 days.

In severe infections the initial parenteral dose of sodium sulfadiazine is based on 0.06 gm. per kilogram of body weight. This is followed by sulfadiazine given orally on the basis of 0.15 gm. per kilogram of body weight per day. The total amount is divided into 6 doses and given every 4 hours until the temperature has been normal for 5 days. The dose then is decreased slowly until the patient becomes ambulatory.

In the treatment of acute or spreading peritonitis, maximum blood levels should be maintained by the intravenous route, in order to avoid administration of the drug by mouth. In many cases it will be desirable to supplement or supplant sulfonamide therapy with the administration of adequate amounts of penicillin. In cases of *escherichia coli* infections, streptomycin would be worth trying if available, possibly in conjunction with sulfadiazine administration.

#### SULFAMERAZINE

Sulfamerazine (sulfamethyldiazine), *p*-amino-N-2-(4-methyl pyrimidyl) benzenesulfonamide, is similar in its uses and mode of action to sulfadiazine except that comparable blood concentrations are obtained with approximately one-half the amount of sulfamerazine as is required of sulfadiazine (71). The drug is more rapidly and more completely absorbed from the gastrointestinal tract than is sulfadiazine; therefore, it may be given in smaller amounts and, since it is excreted more slowly than is sulfadiazine, less frequently.

The distribution in the body tissues is about the same as that of sulfadiazine, and its over-all toxicity is no greater. The acetylated form of sulfamerazine is more soluble in urine at pH 7 or less than either the free or acetylated forms of sulfadiazine, and free sulfamerazine is more soluble than sulfadiazine in neutral or acid urine. The formation of drug concretions and renal parenchymal injury seem to be less likely to occur with sulfamerazine than with sulfadiazine, if equal blood concentrations of the drug are compared. In the absence of urinary complications, no great advantage seems to be gained by the administration of sodium bicarbonate concomitantly with sulfamerazine since the conjugated form of sulfamerazine is relatively soluble in neutral and acid urine and, as Beyer *et al.* (5) have shown, the

administration of sodium bicarbonate increases the renal clearance of all absorbable sulfonamides by interference with their reabsorption. This effect is more striking in the case of sulfamerazine than in that of sulfadiazine, so that alkalinization makes the maintenance of adequate blood levels of sulfamerazine somewhat difficult without significant decrease of the chances of urinary complications.

The statements concerning the bacterial specificity of sulfadiazine are applicable to an approximately equal degree with respect to sulfamerazine.

Another absorbable sulfonamide which is available for essentially the same indications as those outlined for the sulfonamides already discussed is sulfapyrazine (2-sulfanilylaminopyrazine). However, this compound appears to be effective against certain strains of *shigella paradysenteriae*, even when these are resistant to other sulfonamides.

#### INTESTINAL BACTERIOSTATIC SULFONAMIDES

Of the sulfonamides which are poorly absorbed from the gastrointestinal tract, succinylsulfathiazole and phthalylsulfathiazole have received the most attention, although sulfaguanidine was one of the first of the sulfonamides to be offered clinically for the specific treatment of infectious conditions of the gastrointestinal tract.

#### SUCCINYL-SULFATHIAZOLE

Sulfasuxidine or succinylsulfathiazole (2-[N-(succinyl sulfanilamide)-thiazole] manifests an extremely low order of toxicity, probably as the result of the fact that it is absorbed from the gastrointestinal tract in extremely small amounts. That the drug possesses a startling ability to lower the coliform count of the stool has been demonstrated in animals and human beings by many investigators (52, 53, 55, 65). Of further importance is the fact that a high concentration of the drug can be maintained in the human intestinal tract, although, due to the low degree of absorption, only extremely low concentrations occur in the blood, rarely exceeding 2 mgm. per 100 c.c. Less than 5 per cent of the total amount of the drug administered by mouth is excreted in the urine. The explanation of the strongly antibacterial action of the drug within the intestinal tract is not clear, since the hypothesis that this is due to the sulfathiazole liberated in the bowel by hydrolysis no longer seems tenable in the light of more recently obtained data concerning the comparative bacteriology of the drug.

To be effective, succinylsulfathiazole must come in contact with all portions of the bowel mucosa;

when this is accomplished, the desired effect is usually attained in from 3 to 5 days. In the presence of enterostomies, diversion of the fecal stream, or exclusion of various segments of the bowel by one means or another, the drug must be introduced directly into each isolated segment by the most appropriate means; otherwise it will not be possible to reduce the bacterial count to satisfactory levels.

The rationale with respect to the use of the drug preoperatively is quite obvious, since by reducing the potential infectivity of the intestinal contents the chances of incurring a surgical peritonitis are lessened and the possibilities of the patient's recovery thereby enhanced. It must be emphasized, however, that chemotherapy should be considered only as a helpful adjunct to careful surgical technique and adequate surgical care; no chemotherapeutic advance, however brilliant, should be allowed to vitiate well established surgical principles.

When the drug is administered postoperatively, a low bacterial count of the intestinal contents is maintained, with the result that there is little distention, and gas pains, nausea, and vomiting are reduced.

For preoperative preparation the following regimen has been suggested by Poth (52) for all patients who do not have complete intestinal obstruction. The patient is placed on a low residue diet, and receives an initial dose of succinylsulfathiazole of 0.25 gm. per kilogram of body weight. Thereafter maintenance doses are given on the basis of 0.25 gm. per kilogram per day, divided into 6 equal parts and administered every 4 hours. No enemas or purgatives should be used. In the course of from 3 to 7 days the stools become small in bulk, semifluid, and relatively odorless. A bacteriologic examination of the feces will show a marked decrease in the coliform organisms. At operation the bowel is found to be collapsed and is relatively free from feces and gas. Operation may be performed on the open colon without undue risk of peritonitis or local abscess formation provided well established surgical principles are scrupulously followed.

The postoperative maintenance level is 0.25 gm. of drug per kilogram of body weight per day, and treatment is continued for from 1 to 2 weeks, according to the convalescent response of the patient.

Everett, Scott, and Steptoe (23) found succinylsulfathiazole effective in the treatment of urinary tract infection due to *escherichia coli* when administered in daily doses of 0.25 gm. per kilogram of body weight. Some of their cases in which

this drug proved effective had been refractory to therapy with other sulfonamides and mandelic acid. The authors suggest that the probable mode of action of succinylsulfathiazole in clearing urinary tract infections due to *Escherichia coli* seems to be the elimination of the source of the infection from the large bowel, which permits the tissues of the urinary tract to overcome the infection by means of their own biological mechanisms. This suggestion provides an interesting line of investigation but requires confirmation by other workers.

Succinylsulfathiazole is of considerable value in safeguarding the patient during the preoperative and postoperative periods from the hazards of infections which are the accompaniment of radical intestinal surgery, but let it never be forgotten that there is no substitute for painstaking technique and surgical acumen.

#### PHTHALYLSULFATHIAZOLE

Sulfathalidine, or phthalylsulfathiazole, is a dicarboxylic derivative of sulfathiazole with action similar to that of succinylsulfathiazole, but it appears to manifest a greater degree of antibacterial activity against the coliform organisms of the intestinal tract at considerably lower dosage levels. Poth and Ross (56) have shown that this drug "is absorbed sparingly from the gastrointestinal tract, that it maintains low concentrations in the blood (0.1 mgm. to 1.5 mgm.), and that it is rapidly excreted in the urine;" it appears that the new drug has from two to four times the bacteriostatic activity of succinylsulfathiazole and that it causes no toxic symptoms in man.

Phthalylsulfathiazole appears useful in the treatment of ulcerative colitis (66, 57, 3) and regional ileitis (33). It has not been shown to be effective as has succinylsulfathiazole in the treatment of dysentery due to *Shigella dysenteriae* and the Flexner and Sonne types of paratyphoid (54, 62, 14).

Phthalylsulfathiazole has been found effective as a prophylactic agent in the suppression of infections occurring in connection with surgical procedures upon the intestinal tract (58, 63, 66), but both Cave and Streicher (66) believe that succinylsulfathiazole is more satisfactory than phthalylsulfathiazole in the preoperative preparation of surgical patients.

The dosage originally recommended for the latter compound varied from 0.05 to 0.1 gm. per kilogram of body weight per day. The evidence presented independently by Cave and Streicher, both of whom have had extensive experience with the drug, suggests that a total daily dose of from 3 to 6 gm. is adequate, and that amounts in excess

of these quantities are both detrimental and wasteful. We are substantially in agreement with these statements.

#### PROPHYLAXIS OF WOUND INFECTIONS

One of the greatest disappointments in the field of sulfonamide therapy has been the failure of this group of compounds to fulfill the high hopes originally held for them as prophylactic agents for the control of wound infections. This subject was intensively investigated by Melency (48) who studied a total of 2,191 cases, including 926 wounds of the soft parts, 674 compound fractures, and 591 burns, treated at nine different centers where records were kept in a uniform manner for a subsequent analysis of all. The cases included patients who received the sulfonamides systematically alone, locally alone, or by both methods.

The data thus obtained afforded little evidence that sulfonamide treatment reduced the frequency of infection. Nevertheless, as has been emphasized (21), it is recognized that sulfonamides may prevent a lethally extensive spread of the infection. It is evident, however, that what the sulfonamides will *not* do is to reduce the liability to either trivial or serious infection of the wound itself. Routine prophylactic administration of sulfonamide, therefore, does not appear to serve any useful purpose, and the baptism of every wound with a sulfonamide, regardless of character or location, certainly is to be decried. As Melency observes, "All of the results seem to indicate that the main dependence of the surgeon in the prevention of infection both in civilian accidental wounds and in the war wounds must be placed upon the well known principles of the surgical care of contaminated wounds: namely, the removal of the devitalized tissue and the contamination, and the rapid restoration of the normal physiology of the part involved. The use of the sulfonamides can in no measure make up for this."

#### ANTIBIOTIC AGENTS

That class of therapeutic agents referred to as the antibiotics has become of dramatic interest within the last few years, although the existence of such substances has been known for a long time. Pasteur and Joubert, as long ago as 1877, were aware that certain airborne organisms inhibited the growth of the anthrax bacillus, and they even suggested that this phenomenon of antibiosis might be useful in treating certain infections. The first serious attempt to apply this principle was made by Emmerich and Loew in 1899, with a substance known as pyocyanase, which was derived from the *Pseudomonas aeruginosa* (bacillus

pyocyanus) and inhibited the growth of diphtheria, cholera, typhoid, and plague organisms. However, in spite of the pursuance of similar lines of investigation by many workers, no purified product of therapeutic usefulness was isolated until the preparation of tyrothricin in 1939 by Dubos (16, 17, 18, 20, 41, 42). Ten years previously, Fleming (26) of St. Mary's Hospital in London had reported the discovery of penicillin, but actual isolation of this substance in a form suitable for clinical use was not reported until August, 1940, as the result of a co-operative investigation under the leadership of Sir Howard W. Florey at the Sir William Dunn School of Pathology at Oxford, England (10).

Subsequently much attention has been directed toward the isolation of other antibiotic substances. Since the activity of both tyrothricin and penicillin had been shown to be mainly against gram-positive organisms, particular interest lay in isolating an agent which would be effective against gram-negative bacteria.

In 1941, Waksman, Woodruff and Horning (70) mentioned a new substance which they were in the process of isolating from the soil organism *actinomyces lavendulae*, and which they termed "streptothricin." This substance possessed considerable activity against gram-negative organisms, but when administered subcutaneously or intravenously to experimental animals frequently resulted in early or delayed death.

In January, 1944, Schatz, Bugie, and Waksman announced the isolation of a substance derived from another soil organism, *actinomyces griseus*, which they termed streptomycin. This differed from streptothricin in that the pure material was less toxic and possessed considerable activity against gram-negative organisms.<sup>1</sup>

Exploitation of the scientific possibilities of the antibiotic field still is in a relatively preliminary stage, but certain generalizations have become apparent which are important with respect to the effective use of such agents as are already available.

Antibiotic substances manifest a marked selectivity, and the optimal conditions for each agent vary widely; the mechanism of action of the various members of this class of substances also is variable. Some substances act by interfering with bacterial cell division, some affect bacterial respiration, and some interfere with the use of certain essential metabolites by the bacterial cell, through a mechanism of either replacement or combination (69).

<sup>1</sup>Streptothricin, although more toxic than streptomycin, also is more active against many gram-negative organisms. On this basis, it may prove more promising than streptomycin for local application.

Although a great many antibiotic substances are known, only three are of practical clinical utility at the present time. These are penicillin, streptomycin, and tyrothricin. Each possesses certain unique characteristics which define its specific therapeutic sphere.

#### PENICILLIN

Penicillin is an extremely active and essentially nontoxic agent against many of the pathogenic gram-positive bacteria, including the pneumococcus, streptococcus, staphylococcus, and clostridia, certain gram-negative organisms, notably the gonococcus and meningococcus, and certain spirochetes, including the causative agent of syphilis. Because of its relative instability, its principal use is by means of the parenteral administration of freshly prepared solutions. Fairly stable preparations of penicillin intended for oral administration are available, but, as McDermott and his associates (8, 47) have shown, the oral dosage is approximately five times that required to maintain a given blood level by parenteral administration. High unitage beeswax and vegetable oil mixtures are available for intramuscular injection, but in our hands these have proved cumbersome for routine use because of the fact that the least amount of moisture in the syringe will solidify the material and cause a great deal of difficulty.

Although penicillin is available now in forms especially designed for oral, topical, and parenteral administration, most infections of a surgical nature require treatment by the latter method. The conditions falling into this category, and for which penicillin has been found to be the drug of choice, have been listed by Keefer *et al.* (44) as follows:

1. All staphylococcal infections with and without bacteremia:
  - Acute and chronic osteomyelitis
  - Carbuncles—soft tissue abscesses
  - Meningitis
  - Cavernous or lateral sinus thrombosis
  - Pneumonia—empyema
  - Carbuncle of the kidney
  - Wound infection—burns
  - Endocarditis
2. All cases of clostridial infections:
  - Gas gangrene
  - Malignant edema
3. All hemolytic streptococcal infections with bacteremia and all serious local infections:
  - Cellulitis
  - Mastoiditis with intracranial complications, i.e., meningitis, sinus thrombosis, and so on

Pneumonia and empyema  
Puerperal sepsis  
Peritonitis  
Endocarditis

4. All anaerobic streptococcal infections:

Puerperal sepsis  
Localized infections elsewhere

5. All pneumococcal infections of the meninges, pleura, and endocardium,<sup>1</sup> and all cases of sulfonamide-resistant pneumococcal pneumonia.

Penicillin is of questionable value in mixed infections in which the predominating organism is gram-negative; nevertheless, it may be tried in desperate cases. These conditions include ruptured appendical abscess with peritonitis, liver abscess, urinary tract infections due to *Escherichia coli*, and possibly rat bite fever due to the streptobacillus moniliformis.

The dosage varies according to the circumstances of each case, but a total daily dosage of 100,000 units should be considered minimal, while serious infections require several times this amount. For intravenous injection, solutions may be prepared containing from 10,000 to 50,000 units per cubic centimeter, or suitable amounts dissolved in the standard saline or glucose infusion solutions. For intramuscular injection, concentrations of from 10,000 to 50,000 units per cubic centimeter of isotonic saline solution are used in order to keep the total volume administered as small as possible.

Since penicillin is excreted extremely rapidly in the urine, administration should be so planned as to maintain a therapeutic concentration of the drug in the blood stream at all times. Beyer *et al.* (4) have shown that the intravenous administration of sodium para-aminohippurate is capable of increasing the plasma concentration of penicillin over that which is procured when penicillin is administered alone. A two-fold increase in the plasma concentration of penicillin was obtained at a para-aminohippuric acid plasma concentration of 7.9 mgm. per 100 c.c., the lowest concentration which was used in the reported experiments. A five-fold increase in the penicillin level was noted at a para-aminohippuric acid plasma concentration of from 47.7 to 46.9 mgm. per 100 c.c. These investigators point out that it is possible to "effect a considerable economy of penicillin or maintain plasma concentrations of the antibiotic agent not heretofore practicable, when penicillin together with sodium para-aminohippurate is administered continuously by venoclysis."

<sup>1</sup>To this listing we would add pneumococcal peritonitis, which is by no means a rare occurrence in children.

## STREPTOMYCIN

Streptomycin, although manifesting some activity against certain gram-positive organisms, is principally effective, as has already been indicated, against a relatively limited number of gram-negative organisms. It is stable in the dry state at room temperature for at least from 6 to 9 months when the moisture content does not exceed 3 per cent. Present standards require that the minimum potency of the product intended for parenteral use should be equivalent to not less than 20 per cent of pure streptomycin base per gram. In other words, 5 gm. of streptomycin for parenteral use should be equivalent to not less than 1 gm. of crystalline streptomycin base.

Until the question of toxicity has been more fully clarified and our knowledge concerning the pharmacology and clinical use of this substance has been considerably broadened, it would appear that there are no advantages to intravenous injection which would outweigh the potential disadvantages, and therefore it has been recommended that the intravenous route be avoided in so far as possible. The desirable routes of administration are intramuscular (either intermittent or continuous administration), subcutaneous, intrathecal, intraperitoneal, and intrapleural. The drug has also given striking results when administered by nebulization in combination with penicillin, against both gram-positive and gram-negative flora. For parenteral use solutions should be prepared so that each cubic centimeter contains not less than the equivalent of 50 mgm. of crystalline streptomycin base, in order to keep the volume of each injection as low as possible.

The usefulness of streptomycin in the treatment of typhoid infections in human beings has not been confirmed, and hopes for its effectiveness in the eradication of the typhoid carrier state have been doomed to disappointment up to this time. Zintel, Flippin, Nichols, Wiley, and Rhoads (72) however, have shown that streptomycin, when given by mouth, is retained in the intestinal tract and acts as an excellent intestinal antiseptic, and it may prove to be better than the sulfonamides in this respect. Streptomycin exhibits considerable activity in the control of tuberculosis in guinea pigs, but its effective role against the disease in human beings has yet to be substantiated by clinical demonstration in a statistically significant series of cases. Such a study now is in the process of organization upon a large scale. For the present at least, it is urged that streptomycin be used only after careful consideration of the potential benefits to be expected and that its use be limited to cases of infection by pas-

teurella tularensis, bacillus proteus, escherichia coli, pseudomonas pyocyaneus, pasteurella cholerae, pasteurella pestis, hemophilus influenzae (meningitis), brucella melitensis, Friedlaender's bacillus (klebsiella), salmonella, and certain cases of tuberculosis involving the genitourinary tract, the gastrointestinal tract, the meninges, pleura, and peritoneum. The benefit to be expected in tuberculous systemic infections should be anticipated with reserve.

The dosage varies from the equivalent of from 1 to 3 gm. of crystalline streptomycin base per day, the average dosage being the equivalent of 1 gm. a day. It need not be injected more frequently than every 4 to 6 hours because of the fact that it is excreted more slowly than penicillin. The average single dose is from 0.1 to 0.2 gm. or more as governed by the exigencies of the case. Not infrequently an early histaminelike reaction may be noted, characterized by flushing of the face, nausea, vomiting, headache, deafness, or faintness. As a rule, this type of reaction yields readily to the administration of epinephrine. A moderate rise in temperature usually follows each injection. Delayed reactions also may occur, but as little pure material has been available for study, final conclusions concerning the toxicity of this substance may not yet be drawn.

#### TYROTHRIN

One feature which penicillin and streptomycin have in common is that they are antibiotics of which the therapeutic effect is achieved principally by systemic administration; this differentiates these substances from tyrothricin, which, for reasons to be discussed, is used only for topical application, and never parenterally or orally. This characteristic aroused our interest when it became apparent, on epidemiological grounds, that the topical use of sulfonamides, and possibly of penicillin, by large masses of our population was potentially hazardous. Because tyrothricin appeared to offer promise as a therapeutic improvement over the sulfonamides and certain other antibacterial agents for topical application, and a means of avoiding the dangers possibly inherent in the indiscriminate use of the sulfonamides and penicillin, the desirability of utilizing this agent for purposes of topical antisepsis was investigated.

That tyrothricin, which is a mixture of two substances (gramicidin and tyrocidine), exerts an antibacterial action against a large number of organisms has been known for a long time, although no study defining the exact extent of the bacterial spectrum for tyrothricin has, as yet,

been reported in the literature. Unfortunately, most of the published reports concern themselves with a limited group of organisms and none presents a comprehensive review of the problem. The data obtained by the different investigators are not always comparable since the mediums used and the cultural conditions under which the tests were performed varied widely.

In co-operation with Dubos, a systematic survey of the effect of gramicidin and tyrocidine on a large variety of microbial species under standardized conditions was undertaken. It was found that the antibacterial action of gramicidin is unaffected by any concentration of serum albumin; in fact, as observed by Dubos (10), this activity seems to be appreciably increased in this medium. On the contrary, tyrocidine, the other component of tyrothricin, is, like other antiseptics, largely inhibited by albumin. Gramicidin does not kill the spores of aerobic or anaerobic sporulating bacilli, but only inhibits their multiplication. In the case of a few nonsporulating species (Lancefield group D streptococci, in particular) the effect of gramicidin is essentially bacteriostatic. In general, however, the bactericidal level is very close to the bacteriostatic level and this is particularly true in the case of the pathogenic species which we have tested. Although this survey is far from complete, the results at the present time permit a few statements which have been summarized elsewhere (35).

Concerning the antibacterial effect of tyrothricin *in vivo*, as studied under clinical conditions, there is abundant evidence. Suffice it to say that its successful clinical use has been reported by a number of investigators in such conditions as localized infections (59), chronic ulcers of the extremities (36, 45), mastoid cavities (13), empyema (59), and certain pyodermatoses (59), and as an irrigating solution in the treatment of sinusitis (13), eye infections (34), and various types of urinary bladder infections (59), and in the preparation of infected wounds for skin grafting (37). The Russians (28) have used a similar though considerably less active material, which they call "gramicidin S," in the treatment of infected gunshot wounds, osteomyelitis, and similar conditions, with considerable reported success.

The optimal therapeutic concentration of tyrothricin, with consideration of the local tissue toxicity and the maximal antibacterial effect, as originally demonstrated by Herrell and Heilman (37, 38, 39, 40), is in the neighborhood of 500 micrograms per cubic centimeter, and this concentration is widely used today for therapeutic application.

On the basis of data obtained from experiments designed to demonstrate the antiseptic activity of thyrothricin *in vivo*, published elsewhere (35), it is clear that thyrothricin exerts a rather remarkable local antiseptic effect, and in inoculated wounds<sup>1</sup>, sterilization or reduction of the infection to a point where it was readily cared for by the tissues' own biological mechanisms was achieved.

Many antibiotic agents have proved impractical because of toxicity, even though some have possessed a high degree of antibacterial activity. That thyrothricin possesses a remarkably low local tissue toxicity was first demonstrated by the tissue culture studies of Herrell and Heilman (38, 39, 40).

The only striking toxic manifestation of thyrothricin is its hemolytic effect upon the red blood corpuscles when the material is injected experimentally into animals by the intravenous route. This phenomenon constitutes the principal reason that thyrothricin cannot be used parenterally; however, it is of no moment whatsoever when thyrothricin is used topically or in the treatment of body cavities not directly connected with the circulatory system, or in the treatment of open wounds. Even in the latter case, should active bleeding be present, no absorption of the thyrothricin could be expected, nor would any untoward effects be anticipated, since whatever thyrothricin were present would be washed away by the flow of blood before any absorption into the blood stream could occur. In any event, the amounts of thyrothricin present would be far too small to exert any untoward effect even if actually injected intravenously into a small experimental animal.

Grolnick (32) has exhaustively studied the question of whether thyrothricin is capable of causing sensitization. In 171 subjects on whom a solution of thyrothricin containing 1, 2, 5, or 10 mgm. per cubic centimeter had been applied by patch test for a 2 day period, there was no evidence of primary irritation. Twenty-five subjects who had been treated by a 7 day application of a solution containing 10 mgm. per cubic centimeter did not become sensitized to thyrothricin. Finally, sensitivity to thyrothricin failed to develop in 41 subjects who had been given repeated applications with adhesive compresses impregnated with thyrothricin over a prolonged period.

Keefe (43) found no positive reactors in 105 patch tests, and Cooke and Finkelstein (12) tested

a total of 82 subjects without observing evidence of sensitization.

It may be concluded with reasonable assurance, therefore, that although sensitivity is not uncommon in the case of the sulfonamides, penicillin, certain commonly used surface antiseptics, and possibly streptomycin, thyrothricin has not produced sensitization of the skin under the conditions of the experimental studies so far carried out, and if it occurs clinically, experience would seem to be sufficiently large to warrant the conclusion that it must be very rare.

Thyrothricin is available for topical application in the form of ointments, impregnated gauze dressings, and concentrates for preparing solutions. From the standpoint of topical application, its use should be considered complementary to that of the systemic antibiotics.

#### CONCLUSIONS

It is difficult, in summary, to lay down set rules stipulating the use of specific drugs in given instances, since circumstances so largely govern cases.

In general, sulfonamides in pneumococcal and aerobic streptococcal systemic infections may be used except in gravely ill patients, for whom we prefer maximal doses of penicillin with or without a sulfonamide. In serious staphylococcal infections, penicillin should be used. Of the absorbable sulfonamides, we prefer sulfadiazine or sulfamerazine, the latter being preferable in children because of smaller and less frequent dosage.

In urinary tract infections, especially those due to susceptible strains of *Escherichia coli*, sulfadiazine appears to be the agent of choice unless streptomycin is available and the infecting bacterial strain is susceptible to that antibiotic.

In lymphogranuloma venereum, sulfadiazine is effective in early cases but penicillin is contraindicated.

In clostridial infections, penicillin must be used promptly and in maximal dosage together with antitoxin and definitive surgery. Reliance should not be placed on sulfonamides alone in this condition.

For the preoperative preparation of patients for intestinal surgery, succinylsulfathiazole is to be preferred despite the mechanical drawback of the large number of tablets required for proper dosage. This drug gives an added factor of safety in all cases of operative appendicitis, in which peritonitis is of potential consequence. For certain infections of the intestinal tract, such as ulcerative colitis, ileitis, and diverticulitis, phthalylsulfathiazole may be superior.

<sup>1</sup>Some wounds were inoculated with a 0.5 c.c. of a 10<sup>-3</sup> dilution of group C hemolytic streptococci, with these cultures equivalent to about 10,000,000 organisms per cubic centimeter. Other wounds were inoculated with a contaminating concentration of 10<sup>-3</sup> of staphylococcus aureus.

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For topical application, there seems little justification for the continued use of the sulfonamides. Tyrothricin is an excellent agent for this purpose, particularly for the irrigation of empyema cavities and the urinary bladder, since its activity is not decreased in the presence of purulent discharges. The local use of tyrothricin frequently may be combined advantageously with the systemic use of penicillin or the sulfonamides. Tyrothricin also is satisfactory for the treatment of vascular ulcers of the extremities, the preparation of infected areas for skin grafting, and the topical prophylaxis of gram-positive wound infections.

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# ABSTRACTS OF CURRENT LITERATURE

## SURGERY OF THE HEAD AND NECK

### HEAD

Otte, J.: Thrombophlebitis of the Lateral Sinus (Thromboflebitis del seno lateral). *Rev. otorr.*, 1945, 5: 173.

The most frequent complications of suppurative otitis media in descending order of frequency are thrombophlebitis, leptomeningitis, encephalitis, and brain abscess.

Some authors state that sinus thrombosis is facilitated by an exposure of the sinus in the course of the mastoid operation, but the writer has not observed this complication among more than 100 cases in which the lateral sinus had been denuded.

Thrombophlebitis of the lateral sinus may assume various clinical forms according to the intensity of the process, virulence of the pathogenic microorganisms, and resistance of the patient. The main clinical sign is the high temperature with daily remissions. As a rule, the general condition of the patient is good in contrast to the seriousness of the disease. The patient does not complain of headaches, there is no mental confusion nor labyrinthian sign, and with purulent otitis media shows signs of thrombophlebitis and involvement of the brain, intracranial abscess, must be suspected.

While some workers advocate ligation of the internal jugular vein, others do not favor it. The author recommends the ligation for selected cases and believes that penicillin will greatly limit this surgical method.

The author reports 2 cases of typical thrombophlebitis without complications which were treated unsuccessfully with large doses of sulfa drugs and required ligation of the internal jugular vein.

The disadvantage of the ligation is the interference with the blood supply to the brain. In 1 of the author's cases, signs of cerebral involvement in the form of hemiplegia, headache, vomiting, and facial paralysis appeared 15 days after ligation of the jugular vein. A diagnosis of cerebral abscess was made and the patient recovered after operation.

The author describes 3 cases of atypical thrombophlebitis. In 2, a cerebral abscess masked the characteristic symptomatology of thrombophlebitis. In 1 case, thrombophlebitis of the lateral sinus was followed by meningitis in spite of ligation of the internal jugular vein and the administration of large doses of penicillin. The autopsy revealed tuberculous meningitis.

As to the diagnosis of thrombophlebitis, intercurrent general diseases can be excluded only by careful clinical examination.

Thrombophlebitis of the left lateral sinus is frequently complicated by a cerebellar abscess, while an infection of the right sinus is more frequently followed by the development of a cerebellar abscess.

As to the treatment, all the diseased tissue must be removed and the involved sinus must be widely exposed. Penicillin should be administered and the jugular vein should be ligated if the septic picture does not subside. If a thrombosis of the bulb develops, Ramadier's resection should be performed.

JOSEPH K. NARAT, M.D.

Clark, H. B., Jr.: A Study of 150 Cases of Fracture of the Upper Jaw in an Overseas Maxillofacial Center. *J. Oral Surg.*, 1945, 3: 286

From a group of injuries of the face and jaws which passed through a maxillofacial center in Italy between the months of April, 1944, and February, 1945, 150 cases of fracture of the maxilla were taken for detailed study. Eighty-five per cent of the patients were injured under battle conditions, 50 per cent suffering injury from mortar and artillery shell fragments, 20 per cent from bullets, 10 per cent from vehicle accidents, 8 per cent from a blow by a fist or blunt instrument, and 5 per cent from falls.

The treatment of these injuries in forward areas was evaluated. Many of the patients requiring intermaxillary fixation had an appliance in place when they arrived at the maxillofacial center. Another group of 23 had no fixation and fixation was accomplished at the center. There was no significant difference in the progress of these two groups so far as the ultimate union of the maxilla was concerned. Only 3 in the entire group of 150 maxillae developed a degree of nonunion. On the other hand, when soft tissue wounds were left open for periods up to 1 or 2 weeks, a low grade surface infection developed which was attended by the gradual laying down of scar tissue and increasing disability. The author is of the opinion that disfigurement and deformity can be prevented to a great extent by meticulous primary débridement and layer repair as soon after injury as possible. There appears to be no sharp limit to the period in which primary repair can be successfully carried out. From this vantage point in the chain of evacuation the author was able to see repeatedly that the wounds which had been submitted to early and careful, albeit lengthy and tedious, layer repair were far ahead of those wounds which had been débrided and left open, requiring daily changes of soggy and malodorous dressings.

Upon arrival at this center the patient was carefully evaluated and pertinent laboratory data were procured. Indwelling nasogastric tubes were used when swallowing required painful effort. Continuous hot saline packs were applied to all areas exhibiting

any degree of swelling or sepsis. In all cases of wired teeth, spraying followed each feeding and the patient was encouraged to brush his teeth as often as possible.

Of the complications seen, maxillary sinusitis was the most frequent. It is virtually impossible to fracture the body of the maxilla without producing some degree of hemorrhage into the antrum. Eighty cases, or 53 per cent, showed some degree of sinusitis either clinically or roentgenologically, and 28 cases, or 18 per cent, required either a Caldwell-Luc operation or antral window construction rather urgently. This procedure was required 3 times as often in injuries not from missiles as in those caused by a projectile. This is probably associated with the production of an artificial nasal window by the missile, which gives ventilation and drainage to the antrum. Trismus occurred temporarily in nearly all of the face cases but was present as a late consideration in 17 cases, or 11 per cent, all but 2 of which had associated fractures of the mandible. Atresia of the nares occurred in 15 cases. Wound sepsis, chronic intraoral fistulas, malocclusion, and osteomyelitis were present in a small percentage of cases. Secondary hemorrhage did not occur. Nonunion of the maxilla resulted in 3 cases, or 2 per cent.

Of the 125 patients who were battle casualties, one-third returned to duty and two-thirds returned to the Zone of the Interior. Of the 25 civilians, two-thirds returned to duty and one-third went home.

FREDERICK W. MERTFIELD, M.D.

**Barrera, G.: Osteomyelitis of the Jaws. Therapeutic Suggestions (Osteomielitis de maxilares. Conceptos sobre tratamientos). Arch. soc. cir. hosp., 1945, 15: 784.**

Osteomyelitis of the jaw may be of hematogenous origin and may follow scarlet fever, typhoid fever, or furuncles. In such cases the process is diffuse. A circumscribed lesion may follow a fracture or an infection of the teeth, usually of the lower molar teeth. A periapical osteitis may lead to the development of osteoperiostitis or osteomyelitis. Among the responsible bacteria the following must be mentioned: the aerobic and anaerobic streptococcus, the staphylococcus albus or aureus, and the pneumococcus. The spirillum combined with the fusiform bacillus is usually responsible for the characteristic fetor. The *leptothrix buccalis* and *lactobacillus* are found less frequently.

Among the signs and symptoms the following can be mentioned: pain in the involved area, tumefaction of the submaxillary suprahyoid regions and the lips, trismus caused by contracture of the levator muscles, hypesthesia of the skin of the chin, fever, tachycardia, pallor, and profuse perspiration.

As to the evolution, fistulas may form and, unless treated, they may create new abscesses. Extensive phlegmons may form at the base of the oral cavity or in the temporal fossa. Formation of a sequestrum may produce a pathological fracture.

Conservatism is advisable in the treatment of osteomyelitis of the jaw. Surgical procedures should

be confined to cases with circumscribed lesions in which it is possible to remove the sequestrum without interference with the teeth or alveolar processes. Fracture may be prevented by immobilization of the lower jaw, with the oral cavity occluded. In this manner a reparation of the bone and limitation of inflammatory processes in the soft parts can be facilitated. The parenteral use of penicillin is indicated in acute osteomyelitis of dental origin. In chronic osteomyelitis the usefulness of penicillin is more limited, but the drug is apt to diminish suppuration and facilitate drainage. After elimination of sequestra, the combined local use of sulfa drugs and penicillin suppresses postoperative drainage and produces spectacular curative effects. Inasmuch as it is difficult to predict whether an acute process of dental origin will terminate in the development of osteomyelitis, parenteral administration of from 800,000 to 1,000,000 units of penicillin is always advisable.

Since the introduction of modern chemotherapy, complications in the form of septicemia or septicopyemia are very rare. Quartz lamps greatly alleviate the symptoms caused by abscesses and phlegmons.

JOSEPH K. NARAT, M.D.

**Jacoby, N. M., and Sagorin, L.: Osteomyelitis of the Jaws in Infancy. Arch. Dis. Childh., Lond., 1945, 20: 166.**

Osteomyelitis of the maxilla is a rare condition, about 80 cases having been reported since 1847. It is practically confined to infants under the age of 12 weeks, whose previous history in relation to delivery and feeding is not significant. Usually, the condition has progressed for several days before it is recognized as being one of more than merely local inflammation. (In the present cases, this period averaged 8 days). The characteristic feature is gross swelling of the affected side. In the case of the maxilla, both eyelids are involved with proptosis and chemosis; the cheek is remarkably swollen and indurated. In addition there is frequently a unilateral purulent nasal discharge, and occasionally pus discharges externally from below the inner canthus of the eye. Inside the mouth the alveolus and the hard palate are swollen and inflamed, and the sinuses may be discharging either from the alveolus or the buccogingival fold; the buccogingival space may be markedly narrowed. When the mandible is involved, the swelling is mainly in the submental region, while inside the mouth, although the lower jaw is affected, the condition is essentially the same. From any of the purulent discharges, staphylococcus aureus can be cultured.

The etiology of this condition is not completely explained, since the portal of entry of the staphylococcus is unknown. A blood culture was taken in 1 of the cases reported by the authors, and a heavy growth of staphylococcus aureus was obtained within 24 hours. In the case of the maxilla, the bone infection is presumed to start in the tooth socket of the first molar.

The primary treatment in the first case was by operation on the maxilla, which in retrospect was far too radical, and without such interference there would probably have been a smaller loss of deciduous teeth. Subsequent experience showed that the best procedure is to rely mainly on penicillin and to carry out only such surgical measures as may be necessary to remove obvious collections of pus. Thus, while in case 1 an operation was performed first and penicillin was used afterwards, in the 2 subsequent cases penicillin was used from the very beginning and it was found that no surgery was required.

In case 2, in which the mandible was involved, a second prophylactic course of penicillin was given one week after termination of the first, as, in view of the recurrences reported in other cases of osteomyelitis, it was thought that a second course might help to prevent such a recurrence here. In the cases of maxillary involvement, the response to initial treatment was excellent and, considering the vascular nature of this bone in infancy, it was not thought necessary to repeat the penicillin.

In the past when treatment had consisted of free surgical drainage and, more recently, the addition of sulfonamides, the mortality in 43 cases reported in the literature was 31 per cent. In the present group of 3 cases there were no deaths, and although this series is too small to draw any definite conclusions, the fact that within 24 hours of starting treatment it was obvious that all 3 patients were going to recover and all danger had passed, would indicate that in the future the mortality rate will be low.

The cosmetic result (judging from photographs of published cases treated by surgical drainage) has not been perfect. There are usually one or more scars below the lower eyelid and these scars appear to be fixed to bone with resulting "pitting" of the area. In the first case in which pus was aspirated through the skin, scarring was minimal and there was no disfigurement. The subsequent cases had no scarring.

The loss of tooth buds is a further factor that should be mentioned, as it may lead to deformity and disfigurement when the teeth erupt later on. As the loss of tooth buds is due in part to surgical intervention, it is obvious that when penicillin is used and surgery is minimal, deformity due to the loss of teeth of the primary dentition will also be minimal.

Another point worthy of mention is the remarkable rapidity with which penicillin cures the disease. Thus, whereas the average duration of the surgically treated cases is about  $3\frac{1}{2}$  months, and even after this period some of them still had discharging sinuses, the 3 penicillin treated cases were cured and all sinuses healed in 12 days. ERNEST E. ARNHEIM, M.D.

## EYE

Chamlin, M.: Oculomotor Paralysis with Partial Recovery; Report of a Case. *Arch. Ophthalm., Chic.*, 1946, 35: 23.

An opportunity was offered for the study of the action of various drugs in a case of unilateral internal

and external ophthalmoplegia, probably caused by a cerebral aneurysm. The action of cocaine, homatropine, pilocarpine, and physostigmine on the size of the parietic pupil, both during the stage of complete paralysis and the stage of partial recovery, was observed. Pilocarpine, which is believed to act as a cholinergic substance directly on the sphincter of the iris, caused contraction of the pupil, but physostigmine, which is thought to act by neutralizing the cholinesterase present at the myoneural junction, did not cause any pupillary contraction, probably because the defective third nerve was not producing sufficient acetylcholine to cause miosis. Similarly, cocaine dilated the pupil but homatropine did not.

It was noted that with partial recovery there was no pupillary response to light, but there had returned a normal response to physostigmine and homatropine which indicated that a stronger cholinergic tone is necessary for the light reflex than for response to the drugs. The patient exhibited the pseudo Grafe phenomenon, in which the lid is elevated on looking down.

WILLIAM A. MANN, M.D.

Wiser, H. J.: Eye Injuries in War Casualties Aboard a Hospital Ship. *U. S. Nav. M. Bull.*, 1946, 46: 67.

In 8 per cent of all casualties brought aboard ship, often directly from the beach heads, the eyelids, globe, and adnexa were injured. These injuries were usually associated with multiple wounds of the chest, abdomen, and central nervous system.

In spite of edema and chemosis, the fundus, muscles, and visual fields were examined routinely and roentgenographic plates were obtained. Foreign bodies (bullets, shell fragments, fragments of helmet, coral or lava) were found in practically all cases.

Burns were treated by irrigation, wet dressings, butyn, metaphen, and the instillation of penicillin (2,000 units per cubic centimeter) every 2 hours for a period of 72 hours. In only 2 per cent of flash burns of the eyelids was the cornea or conjunctiva involved.

A sulfonamide was dusted into the lacerated wounds before approximation with sutures; dirt particles were removed or excised to prevent tattooing. Extensive lacerations required plastic procedures.

Superficial lacerations were irrigated, 2 per cent butyn was instilled, and if iritis was suspected the pupil was dilated, and local and systemic penicillin therapy was instituted.

For perforations at the limbus, the prolapse was resected and the perforation covered with a sliding conjunctival flap; physostigmine salicylate was instilled, penicillin ointment introduced, and a pressure bandage applied.

Central perforations were treated by dilatation of the pupil and the application of a conjunctival flap.

For the removal of magnetic foreign bodies in the anterior chamber, a hand magnet was used through a keratome incision; nonmagnetic foreign bodies were removed with forceps. Penicillin and foreign protein therapy were administered in all cases of perforation of the eyeball.

any degree of swelling or sepsis. In all cases of wired teeth, spraying followed each feeding and the patient was encouraged to brush his teeth as often as possible.

Of the complications seen, maxillary sinusitis was the most frequent. It is virtually impossible to fracture the body of the maxilla without producing some degree of hemorrhage into the antrum. Eighty cases, or 53 per cent, showed some degree of sinusitis either clinically or roentgenologically, and 28 cases, or 18 per cent, required either a Caldwell-Luc operation or antral window construction rather urgently. This procedure was required 3 times as often in injuries not from missiles as in those caused by a projectile. This is probably associated with the production of an artificial nasal window by the missile, which gives ventilation and drainage to the antrum. Trismus occurred temporarily in nearly all of the face cases but was present as a late consideration in 17 cases, or 11 per cent, all but 2 of which had associated fractures of the mandible. Atresia of the nares occurred in 15 cases. Wound sepsis, chronic antraoral fistulas, malocclusion, and osteomyelitis were present in a small percentage of cases. Secondary hemorrhage did not occur. Nonunion of the maxilla resulted in 3 cases, or 2 per cent.

Of the 125 patients who were battle casualties, one-third returned to duty and two-thirds returned to the Zone of the Interior. Of the 25 civilians, two-thirds returned to duty and one-third went home.

FREDERICK W. MERRIFIELD, M.D.

**Barrera, G.: Osteomyelitis of the Jaws. Therapeutic Suggestions (Osteomielitis de maxilares. Conceptos sobre tratamientos). Arch. soc. cir. hosp., 1945, 15: 784.**

Osteomyelitis of the jaw may be of hematogenous origin and may follow scarlet fever, typhoid fever, or furuncles. In such cases the process is diffuse. A circumscribed lesion may follow a fracture or an infection of the teeth, usually of the lower molar teeth. A periapical osteitis may lead to the development of osteoperiostitis or osteomyelitis. Among the responsible bacteria the following must be mentioned: the aerobic and anaerobic streptococcus, the staphylococcus albus or aureus, and the pneumococcus. The spirillum combined with the fusiform bacillus is usually responsible for the characteristic fetor. The leptothrix buccalis and lactobacillus are found less frequently.

Among the signs and symptoms the following can be mentioned: pain in the involved area, tumefaction of the submaxillary suprahyoid regions and the lips, trismus caused by contracture of the levator muscles, hypesthesia of the skin of the chin, fever, tachycardia, pallor, and profuse perspiration.

As to the evolution, fistulas may form and, unless treated, they may create new abscesses. Extensive phlegmons may form at the base of the oral cavity or in the temporal fossa. Formation of a sequestrum may produce a pathological fracture.

Conservatism is advisable in the treatment of osteomyelitis of the jaw. Surgical procedures should

be confined to cases with circumscribed lesions in which it is possible to remove the sequestrum without interference with the teeth or alveolar processes. Fracture may be prevented by immobilization of the lower jaw, with the oral cavity occluded. In this manner a reparation of the bone and limitation of inflammatory processes in the soft parts can be facilitated. The parenteral use of penicillin is indicated in acute osteomyelitis of dental origin. In chronic osteomyelitis the usefulness of penicillin is more limited, but the drug is apt to diminish suppuration and facilitate drainage. After elimination of sequestra, the combined local use of sulfa drugs and penicillin suppresses postoperative drainage and produces spectacular curative effects. Inasmuch as it is difficult to predict whether an acute process of dental origin will terminate in the development of osteomyelitis, parenteral administration of from 800,000 to 1,000,000 units of penicillin is always advisable.

Since the introduction of modern chemotherapy, complications in the form of septicemia or septopyemia are very rare. Quartz lamps greatly alleviate the symptoms caused by abscesses and phlegmons.

JOSEPH K. NARAT, M.D.

**Jacoby, N. M., and Sagorin, L.: Osteomyelitis of the Jaws in Infancy. Arch. Dis. Childh., Lond., 1945, 20: 166.**

Osteomyelitis of the maxilla is a rare condition, about 80 cases having been reported since 1847. It is practically confined to infants under the age of 12 weeks, whose previous history in relation to delivery and feeding is not significant. Usually, the condition has progressed for several days before it is recognized as being one of more than merely local inflammation. (In the present cases, this period averaged 8 days.) The characteristic feature is gross swelling of the affected side. In the case of the maxilla, both eyelids are involved with proptosis and chemosis; the cheek is remarkably swollen and indurated. In addition there is frequently a unilateral purulent nasal discharge, and occasionally pus discharges externally from below the inner canthus of the eye. Inside the mouth the alveolus and the hard palate are swollen and inflamed, and the sinuses may be discharging either from the alveolus or the buccogingival fold. The buccogingival space may be markedly narrowed. When the mandible is involved, the swelling is mainly in the submental region, while inside the mouth, although the lower jaw is affected, the condition is essentially the same. From any of the purulent discharges, staphylococcus aureus can be cultured.

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Small metallic foreign bodies in the orbit were not removed unless an inflammatory reaction resulted; larger ones were removed to prevent future trouble.

In zygomatic fractures, depression of the infra-orbital ridge and floor of the orbit resulted in deformity unless the fragments were elevated within the first week. A pack in the maxillary sinus was used to hold the orbital ridge and floor in position.

In fractures of the supraorbital ridge with involvement of the frontal sinus, the bony fragments were replaced, a drain was sutured into place, and the soft tissues were approximated.

In nearly all cases of severe trauma to the orbital wall, the eyeball was ruptured or badly damaged.

Immersion blast injuries were few; atmospheric blast injuries were common. In blast injuries, hemorrhages in the vitreous, choroidal tears, and retinal hemorrhages were present.

Enucleation or evisceration was done without delay when indicated, especially to prevent sympathetic ophthalmia.

The results obtained with penicillin and sulfonamide therapy were very gratifying.

JOSHUA ZUCKERMAN, M.D.

**Duke-Elder, P. M., and Wittkower, E.: Psychological Reactions in Soldiers to Loss of Vision of One Eye.** *Brit. M. J.*, 1946, 1: 155.

One hundred and two soldiers with loss of vision of one eye were studied with regard to the duration of their disability, rank, type of enlistment, age, marital status, and attributability of injury to enemy action. The authors discuss the psychological reactions of these men to their disability. It was found that the type of emotional reaction to the loss of an eye is determined by: previous personality, minor or no emotional maladjustment, social anxiety over dependants, or self-centered, self-pitying anxiety, the nature of the disability, the nature of employment, and the retention of a blind eye.

The authors conclude that because the psychological effect of the loss of an eye is out of proportion to the actual physical disability, treatment is by no means completed with only medical attention to the eye. They believe that measures should be taken not only to improve the occupational prospects of the patient, but also to impress their employers with the fact that in most vocations the loss of one eye results in only a negligible loss of efficiency.

JOSHUA ZUCKERMAN, M.D.

**Schele, H. G., and Hodes, P. J.: Injection of Oxygen into Tenon's Capsule.** *Arch. Ophth.*, Chic., 1946, 35: 13.

The authors discuss the injection of contrast mediums into Tenon's capsule for radiographic differentiation of intraocular foreign bodies from those outside the eyeball. The method is also useful for localizing foreign bodies near the limits of the eyeball and for diagnosing double perforations of the eyeball. They recommend the use of oxygen by injection into Tenon's capsule.

The injection of air with resultant external pressure made immediate surgical intervention hazardous (danger of loss of vitreous, and prolapse of the iris), especially when the anterior chamber had to be opened for removal of a foreign body by the anterior route, or for linear extraction of a traumatic cataract. The injection of carbon dioxide was also tried. It was found that air is not absorbed completely for from 3 to 4 days; carbon dioxide is absorbed too rapidly to be effective as a contrast medium.

Oxygen proved to be ideal for visualization of the eyeball. It was absorbed slowly enough to permit re-examination, yet quickly enough to avoid the risk of escape of vitreous at operation. Most of the oxygen is absorbed within 4 to 8 hours.

The technique described by Spackman is recommended. With a curved 25 gauge needle (attached to a 10 c.c. syringe), inserted from 5 to 6 mm. behind the limbus in the upper outer quadrant of the eye, 6 c.c. of oxygen are introduced slowly to produce proptosis.

JOSHUA ZUCKERMAN, M.D.

**Town, A. E., and Hunt, M. E.: Penicillin in the Aqueous Humor.** *Am. J. Ophth.*, 1946, 29: 171.

Experimental investigation of penicillin concentration in the blood and aqueous of rabbits and monkeys following intramuscular injections was undertaken, using the Rammelkamp method of assay. Aqueous was withdrawn with a fine hypodermic needle and forty minutes later the secondary aqueous obtained. In all cases the penicillin content of the aqueous was found to be very low in relation to the blood level but the secondary aqueous showed nearly as great a concentration of penicillin as the blood.

Clinically the experimental work indicates that massive doses of penicillin are required to produce any effective concentration in the aqueous.

WILLIAM A. MANN, M.D.

**Reese, A. B., and Payne, F.: Persistence and Hyperplasia of the Primary Vitreous (Tunica Vasculosa Lenticis or Retroretinal Fibroplasia).** *Am. J. Ophth.*, 1946, 29: 1.

The condition reported by the authors is manifested as a bilateral congenital lesion in premature infants. The basic lesion is a persistence, in part or in toto, of the primary vitreous, with or without hyperplasia and with or without secondary changes consequent to hemorrhage, opening of the lens capsule, and glaucoma.

As a result of the lowered mortality of premature infants in the past decade, lesions of this type are encountered more frequently now. Clinically, there are 4 types, which may coexist or merge:

1. The typical and most frequent manifestation is a saucer-shaped, whitish opaque tissue conforming to the posterior surface of the lens.
2. An opaque cornea, greatest centrally, and usually associated with glaucoma.
3. A localized area of opaque tissue on the posterior surface of the lens at the equator of the lens.

or in the anterior vitreous, with or without retinal detachment.

#### 4. Remains of the hyaloid system.

For the associated glaucoma, the authors have tried iridencleisis, cyclodialysis, trephining, and iridectomy with sclerectomy, but iridencleisis appears to be the treatment that is most effective. The lens substance can be removed by repeated extensive dissection, and finally by a central vertical cut in the retrolental fibrous tissue with deWecker's scissors.

The authors state that the lesion appears to be related to hemangioma of the skin of the face, the scalp, the body, or the extremities.

JOSHUA ZUCKERMAN, M.D.

**Rados, A.: The Occurrence of Glioma of the Retina and of the Brain in Collateral Lines in the Same Family; Genetics of Glioma.** *Arch. Ophthalm.*, Chic., 1946, 35: 1.

The occurrence of glioma of the retina and of the brain in collateral lines of the same family is discussed. The author points out that heredity depends on the intrinsic factors, the genes, and extrachromosomal influences. In malignant tumors, with the exception of gliomas and neurofibromatosis, heredity is of minor importance. Gliomas are relatively rare.

Elschnig reported a case of unilateral glioma in a girl 2 years of age, whose 13 year old sister died 10 years later of infiltrative glioma of the large hemisphere of the brain.

In the present article, the author reports the occurrence of malignant growths of the same type in the retina and in the brain, in collateral lines of the same family—1 case of glioma of the retina, and 1 of glioma of the brain. The females themselves, who were not affected, were the transmitters to a male and to a female child, respectively.

In conclusion, the author states that retinoblastomas have a hereditary basis and that apparently they originate from lesions which are intermediate between developmental disturbances and true neoplasms.

JOSHUA ZUCKERMAN, M.D.

### EAR

**Hipskind, M. M.: War Injuries to the Auditory Apparatus.** *Laryngoscope*, 1945, 55: 678.

The records show that 5.8 per cent of all patients admitted to the One Hundred and Eighth General Hospital suffered from acoustic trauma. The author reviews 170 case records of soldiers who complained of impaired hearing caused by explosion, and presents the following summary and conclusions.

Combatant personnel exposed to the effects of battle noises have demonstrated a tonal dip maximal at 4,096 cycles when tested in a soundproofed room with a standardized audiometer.

Ear injury incurred in combat, as manifested by a tonal dip, could be recognized before the speech frequency range was affected. The application of this knowledge proved to be a satisfactory basis for the classification and ultimate disposition of soldiers.

Ears with hearing impairment existing prior to military service proved to be as vulnerable as normal ears, when exposed to the noise of combat.

No correlation was found between the degree of objective cardium injuries and the degree of hearing impairment.

Aural battle casualties presented a paucity of complaints referable to the receptors for equilibrium and, more rarely, diplacusis. Deafness was commonly associated with tinnitus. In those patients complaining of tinnitus only, the maximum threshold elevation was at 11,584 cycles.

A method of detection of malingers was developed.

Temporary deafness of the left ear, caused by the muzzle-blast from the soldier's own rifle, appeared to predispose to combat injuries from explosions occurring in the area of the soldier's left side.

Hysterical and simulated deafness was not uncommon. These two types of deafness responded well to proper identification and treatment.

No evidence was found that would indicate a "cumulative factor" in acoustic trauma.

JOHN F. DELPE, M.D.

**Otte, J.: Labyrinthitis (Labyrinthitis).** *Rev. otorr.*, 1945, 5: 216.

Labyrinthitis is a relatively frequent complication of suppurative of the ear occurring in approximately 1.5 per cent of the cases of otitis media. The propagation of infection may follow various paths such as fenestrum ovale, vestibulum, semicircular canals, or the promontory canal of the facial nerve. Rarely, perforation of the eustachian tube may occur.

A circumscribed and a diffuse form of labyrinthitis may be distinguished. If the infection spreads slowly, inflammatory adhesions prevent a further propagation of the infection and a labyrinthian fistula forms. Endosteum is extraordinarily resistant to infections, and because of its excellent vascularization it reacts intensely to an invasion by microorganisms. All such circumstances explain the relatively great frequency of fistulas. A circumscribed labyrinthitis may follow a slow extension of the infection responsible for a chronic otitis media, especially cholesteatoma, while an acute otitis media leads more frequently to a diffuse labyrinthian process.

The author recommends Kopetzky's classification of clinical forms.

Profound modifications in the evolution of labyrinthitis are provoked by penicillin and the sulfa drugs.

The author describes a case of labyrinthitis in which an erosion of the external semicircular canal was found. This focus was eliminated without paying attention to the danger of meningeal propagation.

In a case of perilabyrinthitis no labyrinthian lesion could be found on inspection, but the vestibular apparatus was destroyed with the purpose of putting an end to the dizzy spells. No postoperative complications developed.



The author describes a case of suppurative otitis media complicated by a diffuse serous labyrinthitis and purulent meningitis. The patient was cured with penicillin without surgical intervention. The author believes that since the introduction of new therapeutic methods, especially the use of penicillin, the indications for surgical intervention in labyrinthitis have become more limited. JOSEPH K. NARAT, M.D.

Letellier, R. V.: Petrositis (Petrositis). *Rev. Otorr.*, 1945, 5: 256.

The author reports 4 cases of petrositis. Especially interesting was the case in which a wrong diagnosis had been made: a boy presented a clinical picture of petrositis following a mastoid operation and roentgenograms in Stenvers position revealed an osseous lesion. However, no pathological changes of the petrous bone were found at the operation performed according to Lempert's rules. The autopsy revealed tuberculous meningitis.

The main micro-organism responsible for petrositis is the hemolytic streptococcus. The infection usually spreads across the anterosuperior portion of the promontory and the peritubal zone. Following a mastoid operation, otorrhea and earache persist and the pain radiates toward the periorbital and occipital regions. A paralysis of the facial nerve may develop if the infection involves the anterosuperior portion of the promontory. Diplopia is frequent. Deafness, dizziness, vomiting, and nystagmus may occur when the process is accompanied by a labyrinthian irritation. Gradenigo's syndrome is not typical of petrositis because it may also appear in the course of mastoiditis, meningitis, or thrombophlebitis of the lateral sinus. A gradual disappearance of suppuration and attenuation of the pains are good prognostic signs, while a sudden cessation of otorrhea and the pains should be looked upon with suspicion. A latent period has been observed by the author in 1 of his cases.

Among the general symptoms, asthenia, loss of appetite, and subfebrile temperature may be mentioned. A paralysis of the external branch of the oculomotor nerve seems to occur in more than half of all the cases. Unless there are complications in the brain or meninges the findings in the spinal fluid are negative. Blood examination usually shows a slight leucocytosis. Roentgenography is of considerable value although the interpretation of the findings may be difficult and the otologist must rely chiefly on the clinical picture.

Asymptomatic petrositis has been described. Among the most frequent complications, meningitis and septicemia must be mentioned.

The differential diagnosis should consider osteomyelitis of the petrous bone, thrombophlebitis of the lateral sinus, labyrinthitis, and tuberculous meningitis. As to the clinical forms, the following types may be distinguished according to the location of the infection: basal and apical petrositis, and panpetrositis. Congestive and suppurative forms may be distinguished.

As to the evolution of the process, a spontaneous recovery may occur, or the condition may become chronic. Spontaneous perforations may develop and reach the contents of the skull, the pharynx, or the carotid canal.

Chemotherapy apparently does not prevent the spread of the infection and therefore surgery is unavoidable. The author has been using Lempert's operation with great success. If patients who have undergone a mastoid operation complain of periorbital pain, a careful search for fistulous tracts at the base of the petrous bone is indicated. Unless the process is located at the apex of the petrous bone, a complete petromastoid operation will cure the petrositis. JOSEPH K. NARAT, M.D.

Smith, A. T.: Clinical Use of Penicillin in Infections of the Ears, Nose, and Throat. *Arch. Otolaryng.*, 1946, 43: 12.

The author reviews his experience with the use of penicillin in the treatment of ear, nose, and throat infections at the U. S. Naval Hospital, Portsmouth, Virginia, since 1943.

There was no response to penicillin in the cases of patients with chronic suppurative otitis media; however, in acute suppurative otitis media, which was due to penicillin sensitive organisms in nearly all cases, the response to systemic treatment was prompt and often dramatic.

In cases of mastoiditis with complications requiring mastoidectomy, penicillin played an important part in recovery, and in the rapid healing of wounds.

Acute multiple sinusitis responded favorably to systemic therapy, and surgical work was greatly reduced. It was difficult to determine the value of local therapy in maxillary sinusitis. The general impression was that a combination of systemic and local treatment was better than the use of either method alone. In chronic sinusitis with mixed infections, it was not clear that penicillin was an aid to the usual local treatments and operative procedures.

Penicillin was valuable in the treatment of acute follicular tonsillitis, but was not of value in the treatment of rheumatic fever and infectious mononucleosis. It was of value, however, in the treatment of Ludwig's angina and cellulitis, and in adenitis complicating dental surgery. In cases of osteomyelitis of the mandible, surgical treatment also was necessary.

JOHN R. LINDSAY, M.D.

## NOSE AND SINUSES

Callomon, F. T., and Linton, L. G.: Tissue Changes Produced in the Nasal Mucous Membrane of Normal Mice by Prolonged Local Administration of Some Solutions Containing Sulfonamide Compounds. *Arch. Otolaryng.*, Chic., 1946, 43: 31.

The authors carried out a series of experiments on mice, to determine the histological changes occurring in the nasal mucous membrane as a result of the prolonged local administration of several solutions

containing sulfonamide compounds. The solutions were dropped into the nose twice daily and the animals were killed at various periods. A 3 per cent solution of propylene glycol alone (pH 5.4) had no detrimental effect on the mucosa, nor did an isotonic solution of sodium chloride produce a detrimental effect. Three per cent sulfathiazole in propylene glycol (pH 5.1) produced only a slight inflammatory reaction. Two per cent diaseone in propylene glycol (pH 4.8) caused considerable inflammation of the mucous membrane with moderate alteration of the olfactory layer. These changes increased when treatment was prolonged. The addition of 10 per cent sodium bicarbonate to 3 per cent diaseone in propylene glycol (pH 8.8) produced increasing inflammatory reaction. Other preparations of diaseone, succinylsulfapyrazine, and a commercial preparation containing desoxyephedrine and sodium sulfathiazole in aqueous solution (pH 9.2) showed similar marked inflammatory reaction in the mucosa, followed by a slow return to normal after the treatment was ended. The 2 per cent diaseone solution with a pH below 5 caused much greater damage than the alkaline solution with pH 8.8.

JOHN R. LINDSAY, M.D.

Wolf, G. D.: Colloidal Nasal Tamponades. *J. Am. M. Ass.*, 1946, 130: 273.

The use of nasal tamponades saturated with a solution of mild protein silver in nasal therapeutics is discussed.

Although this method of therapy has been widely used, there is no unanimity of opinion as to its value, recognized authorities expressing divergent opinions. Direct scientific proof of its value has not been demonstrated.

The effectiveness of colloidal silver is said to be due to its immediate irritant properties, resulting in stimulation of the flow of mucus, and a subsequent mild antiseptic effect which is in proportion to its free silver ions. The strong protein silver group, according to "New and Nonofficial Remedies," is most effective, but is slightly irritant and stimulant, while the mild silver protein salts (U.S.P.) act largely as a demulcent and a detergent through the dislodging of pus.

Physiologic studies show that the nasal and sinus mucosa is covered by a thin film of mucus which is swept along by ciliary action to the nasopharynx and eventually reaches the pharynx and stomach. This provides a natural defense for the upper respiratory tract against infection. Ciliary action is not necessarily aided by the use of antiseptics.

While scientific evidence suggests that colloidal silver has no value in nasal therapeutics, the author has found the use of nasal "packs" to be of value in a selected clinical group.

They were of no value in purulent sinusitis, or in the presence of physical obstruction, such as deflected septum, hypertrophied turbinates, and polypi, or in allergic patients. A group of patients, usually plethoric in type, was found, however, who complained

of vague headaches, nasal stuffiness, and discharge, and who experienced marked relief after treatment with 10 per cent colloidal silver solution on packs.

Prolonged use of nasal tampons for treatment of chronic sinusitis has no place in nasal therapy.

JOHN R. LINDSAY, M.D.

## MOUTH

Waldron, C. W., Peterson, R. G., and Waldron, C. A.: Surgical Treatment of Mandibular Prognathism. *J. Oral Surg.*, 1946, 4: 61.

In approaching the problem of mandibular prognathism, a careful and thorough diagnostic study of the individual case is essential. The history should include any deformities in parents or other members of the family, and the presence of nasopharyngeal obstruction in the patient, which may have caused voluntary protrusion of the lower jaw in an effort to secure an adequate airway. Photographs, x-rays of the jaws, dental examinations, and duplicate impressions and casts of the upper and lower teeth with bite recordings should be made.

By matching the lower cast with the upper cast, a preliminary estimation of the occlusal relationship after surgical replacement is usually possible. It can then be determined whether orthodontic treatment of the upper or lower teeth of both arches is indicated before or after surgical repositioning. Also, a careful study of the casts may indicate whether excising sections of the body of the mandible or osteotomy of the ramus is the operation of choice. To facilitate in this planning, a special mount or articulator for the casts is used (Fig. 1).

The operative method employed is selected according to the needs of the individual case. In many the desired correction may be obtained by excision of a section of the body of the mandible in the retromolar region, either unilaterally or bilaterally. The predetermined length of bone is removed under direct vision through a submandibular approach, preserving the alveolar nerve if possible, and the bone ends are fixed in approximation with silver wire. Immobilization of the jaws is maintained by interdental wiring for a period of 8 weeks.

In some cases examination of the casts will indicate that occlusion would be better established by means of diagonal osteotomy and resection of a previously estimated amount of bone from the ramus just above the angle of the mandible, or by horizontal division of the ramus and wiring of the fragments after setting back the lower fragment the desired distance. Approach to the ramus is made through an incision placed 1 cm. behind and slightly below the attachment of the lobe of the ear, and extending downward for a distance of  $1\frac{1}{4}$  inches in a line parallel with the posterior border of the ramus. The parotid fascia and gland are bluntly dissected to expose the periosteum along the posterior margin of the ramus. Transverse sectioning of the ramus is made no lower than  $\frac{1}{2}$  inch below the mandibular notch in order to avoid injury to the inferior alveolar

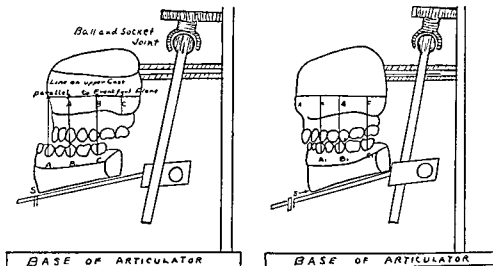


Fig. 1. Diagrammatic plan of the articulator we are using for preoperative study of the procedure to be carried out. Measurements in the vertical plane from A to A', B to B', C to C', are checked on the repositioned cast to determine the elevation or depression of the anterior or

posterior teeth indicated to obtain the best possible occlusion. By these determinations, an estimate may be made of the necessity of a diagonal section of the ramus rather than section through the horizontal plane.

vessels and nerve. Fixation is attained by wiring of the fragments and by intraoral wiring. In edentulous patients it may be necessary to resort to some form of external fixation. In special instances, such as coexistent cleft palate deformities, the operative correction of the mandibular deformity is planned in conjunction with dental or prosthetic work on the maxilla.

In the authors' series there was usually seepage of parotid fluid from the incisions, lasting from 3 or 4 days to as long as 23 days. In a few cases partial facial paralysis developed, in no case occurring bilaterally, or persisting permanently. These disadvantages, however, are considered less troublesome than those encountered when an intraoral approach is used, since better visualization of the operative field is attained and the wounds are not contaminated by the oral cavity. Local anesthesia is preferred because of the hazards of vomiting after general anesthesia when the jaws are wired.

The improvement attained in facial appearance, function of mastication, and mental attitude of the patients in a series of some 50 cases has been most gratifying.

JOSEPH J. McDONALD, M.D.

This period, no attempt was made to give the patient fluids by mouth, feeding being entirely by the intravenous route. A nasal feeding tube was inserted as soon as the patient's condition allowed. A high protein liquid feeding every hour proved satisfactory. Penicillin, 20,000 units every 3 hours, was given routinely.

The course of a bullet as determined by the point of entrance and exit did not indicate that the damage caused was limited to its path. The transmitted explosive force in passing through the tissues caused serious remote damage in many instances. X-rays and fluoroscopic examination were often of great assistance in locating and removing foreign bodies.

Perforation of the esophagus should be suspected in all cases in which the larynx or trachea has been injured. Restricting fluids by mouth and feeding by tube is a good policy for all patients in whom any damage to the esophagus is suspected. Damage to the large vessels of the neck must be suspected no matter how small the point of entrance of the foreign body.

It is emphasized that obvious facial injuries may be associated with cord damage, injury to the larynx, trachea, pharynx, esophagus, or large vessels of the head and neck. It is well established also that every severe facial fracture should be considered a basal skull fracture until proved otherwise.

The treatment of facial wounds follows the accepted pattern of treatment of all war wounds. Light closure without drainage should never be done. It was necessary to remove sutures and establish drainage on practically every case which had been closed in this manner before the patient was received aboard. Approximation of the wound with drainage after careful cleansing and conservative débridement was done as soon as possible. Whenever possible, a

Wiser, H. J., and McAfee, M. F.: Injuries of the Face and Neck in War Casualties. *U. S. Nav. M. Bull.*, 1946, 46: 57.

This is a report of neck and face injuries treated aboard a hospital ship. The urgent problems encountered in injuries of the head and neck are shock, hemorrhage, and respiratory distress. Any work which did not come under the urgent classification was postponed until the patient had been thoroughly examined and his condition evaluated. At the end of 24 or 48 hours the patient was invariably in much better condition for anesthesia and surgery. During

pressure dressing was applied. Dirt, powder marks, or other pigmented material required careful removal from facial wounds. The use of a stiff scrub brush and soap are frequently necessary.

It is often possible, by early repair of facial wounds, to shorten a patient's hospitalization by many months. In a high percentage of cases of soft tissue wounds of the face, there was associated trauma to the bony structures. Practically all fractures were compound and comminuted. There was always a considerable amount of shock in this type of injury. Dyspnea was often present and caused the patient much discomfort and apprehension. Tracheotomy was frequently performed in these individuals. In severe injuries it is not considered advisable to attempt fixation of the jaw fragments, elevate the malar bones, or attempt reduction of the nasal bones until the condition of the patient has stabilized, usually after from 48 to 72 hours. Early manipulation adds to the shock of the patient, excites hemorrhage, and increases the danger of meningitis. Arch bars with rubber band traction were used for the reduction and fixation of fractures of the maxilla and mandible.

It can be readily seen that no rule can be set down to govern early treatment of all types of facial fractures encountered in war casualties. In the event of rhinorrhea a minimum amount of manipulation was done. Both penicillin and sulfadiazine were given in all cases in which there was believed to be imminent danger of meningitis.

FREDERICK W. MERRIFIELD, M.D.

**Director of the Institute of Radium: Cancer of the Oral Cavity; Its Location and Frequency.**  
(Cánceres de la cavidad bucal, localización y frecuencia). *Arch. cub. canc.*, 1945, 4: 238.

During the period from 1924 to 1944, 1,329 patients with cancer of the oral cavity had been treated at the Radium Institute in Cuba. The cases were distributed as follows: lips (486 patients), tongue (317), palate (206), tonsils (159), gums (72), base of the mouth (47), and cheeks (42). Cancer of the palate, tonsils, and base of the tongue was responsible for 33 per cent of all cancers of the oral cavity. On the lips the cancer was more frequently located in the center than on the sides. Cancer of the lips was encountered in 37 per cent of the total material.

The upper aspect of the tongue was affected much more frequently than the lower, and the base of the tongue was involved in a much greater number of cases than any other part of the organ. Cancer on the lower aspect of the lips was rare.

Of 206 cancers involving the palate, 152 were found on the soft palate or the pillars, and 54 on the hard palate. The uvula was involved in 44 instances. As to the tonsils, in many cases it was impossible to determine whether one was dealing with a primary carcinoma or a tumor spreading from the pillars or the pharyngeal wall.

The upper gums were the site of cancer twice as often as the lower gums. The middle third of the inner side of the cheeks was invaded by cancer more frequently than any other portion.

JOSEPH K. NARAT, M.D.

# SURGERY OF THE NERVOUS SYSTEM

## BRAIN AND ITS COVERINGS; CRANIAL NERVES

Morrison, L. R.: Histopathological Effect of Anoxia on the Central Nervous System. *Arch. Neur. Psychiat.*, Chic., 1946, 55, 1.

Damage to the nervous system as a consequence of anoxia has been produced in many ways, but most of the investigations dealing with this subject have borne but slight relation to the problem of aviation. The purpose of the present investigation was to determine whether histopathological alterations were produced in the central nervous system after repeated, sublethal exposures to an atmosphere deficient in oxygen; to measure the amount of oxygen to which the nervous system was exposed; and to correlate that amount, if possible, with the nature of the histopathological process. The extensive use of high-flying airplanes in war, with its accompanying hazards of failure of the oxygen supply, jumps from high altitudes, and the possible cumulative effect of the chronic day by day exposures to fatigue and anoxia, makes the need for such an investigation imperative.

The different conditions under which anoxia of the nervous system has been produced may be grouped under the classification of anoxias as suggested by Barcroft, or by Peters and Van Slyke: (1). anoxic anoxia is characterized by low oxygen tension of the arterial blood, so that the hemoglobin does not have its normal degree of oxygen saturation; (2). anemic anoxia is a condition in which insufficient amounts of hemoglobin are available for oxygen transport even though the oxygen tension is normal; (3). stagnant anoxia is the result of defective circulation of the blood during which the tissues fail to receive an adequate supply of oxygen even though the arterial blood contains sufficient oxygen in the proper degree of saturation; (4). histotoxic anoxia occurs when the tissue cells themselves are unable to utilize oxygen even though it is available in the arterial blood.

The authors then describe the materials and methods used in making their experiments, and review the pathological examination of 25 dogs and 10 monkeys subjected to varying types of anoxia. The brains of these animals were studied both grossly and microscopically, and the report includes a great number of photomicrographs showing the changes of the cell structures in different portions of the brain.

A summary of the findings may be given as follows:

Twenty-five dogs were exposed daily to atmospheres of low oxygen concentration at the pressure of sea level, and 10 monkeys were similarly exposed in a decompression chamber. The oxygen content of the arterial blood was measured in the dogs. Histological studies were made of the central nervous system of all of the animals and of the adrenal glands of the dogs.

It was found that a single, sudden exposure to a simulated altitude of 32,000 feet (10,000 meters) for 25 minutes was capable of producing extensive laminar necrosis in the cortex of the monkey.

With repeated exposures to mild hypoxia, it was observed that the first histological changes occurred in the cell bodies of the cortical gray matter. They took place at a level of about 12 or 13 volumes per cent of oxygen in the blood if the exposures were long enough and were repeated often enough.

When the percentage of oxygen was reduced still lower, to about 10 volumes per cent, and the number of exposures was increased, the white matter also became involved and presented a pattern of demyelination in the corpus callosum, the centrum semi-ovale, and the adjacent fingers of subcortical white matter which, in the cases of more severe anoxia, suggested a resemblance to Schilder's disease.

Aside from the lesion of the white matter, frank necrosis was usually found to occur, but only after episodes of anoxia sufficiently severe to produce the cessation of respiration.

The frontal lobe was most often involved and the temporal lobe least often. The cerebellum was more frequently affected than the basal ganglia, and the spinal cord and medulla were unaffected by any degree of anoxia compatible with life. An oxygen level of 4 or 4.5 volumes per cent was about as low as a dog could tolerate. Respirations quickly ceased below that level. The adrenal glands showed increased cortical activity. PAUL MENRELL, M.D.

Wilson, H. M., and Lutz, W. G.: Lesions of the Aqueduct of Sylvius. *Radiology*, 1946, 46: 132.

The first case of congenital occlusion of the aqueduct of Sylvius was reported by Hilton in 1847. Pancoast, Pendergrass, and Schaeffer have stated in their classic work, "The Head and Neck in Roentgen Diagnosis", that of all of the lesions revealed by ventriculography, those obstructing the aqueduct are the most difficult to diagnose. Twining emphasized the danger of being misled by inadequate visualization of the aqueduct and fourth ventricle and discussed the hydrodynamics involved in filling these structures with air.

Complete replacement of the cerebrospinal fluid with air is seldom possible by ventricular puncture in the presence of a blocked ventricular system. The difficulties encountered are largely technical and involve positional occlusion of the system. The roentgen diagnosis is dependent upon failure to visualize the aqueduct, together with the positive findings of obstructive hydrocephalus: namely, (1) symmetrical dilatation of the lateral ventricles; (2) dilatation of the foramina of Monro; (3) dilatation of the third ventricle; and (4) dilatation of the aqueduct rostral to the point of obstruction. These criteria may be established by conventional posi-

tioning in most cases in which an adequate replacement of fluid by air is effected by the neurosurgeon. In some cases, however, the superimposed bony structures of the cranium, or air in dilated lateral ventricles may obscure the region of the aqueduct, which necessitates the use of body section roentgenography. Midline lateral laminagraphs will give clear visualization of the aqueduct and the third and fourth ventricles in such cases. In all instances of failure to visualize the aqueduct or the fourth ventricle by conventional roentgenography, laminagraphs in both the lateral and frontal projections are taken.

The authors discuss the use of heavy opaque media and state that they are not regarded favorably. Definite localization of the site of obstruction in obstructive hydrocephalus is of paramount importance. A surgical decision to explore the lesion above or below the tentorium may rest largely upon ventriculographic findings. In reviewing their ventriculographic studies in cases of obstructive hydrocephalus, it was noted that rotation of the third ventricle on its horizontal axis occurred in a number of instances of subtentorial tumor. In order to evaluate the significance of this finding a group of cases of obstructive hydrocephalus was restudied. A line was drawn along the base of the anterior fossa and a second line was drawn from the anterior clinoid process to the suprapineal recess. The measured angle included between these lines was noted in two groups of proved supratentorial and infratentorial tumors, respectively, and in a control group of normal pneumoencephalograms. It was found that the angle was usually 140 degrees in normal air studies; it was significantly decreased in cases of infratentorial tumors, and was usually increased in non-neoplastic obstruction of the aqueduct above the tentorium.

The authors report 11 cases of neoplastic stenosis and 3 cases of non-neoplastic stenosis. The theories of both geneses of non-neoplastic stenosis are reviewed. The role of nutritional deficiency as an etiological factor is discussed in line with recent experimental evidence.

PAUL MERRELL, M.D.

Walter, W. G., and Dovey, V. J.: Delimitation of Subcortical Tumors by Direct Electrography. *Lancet*, Lond., 1946, 250: 5.

It is not surprising to see that elaborations and additions to the recent science of electroencephalography are already beginning to appear. The authors have created a device for direct measurement of electrical potentials of the brain, "electrography," which consists of an insulated electrode which is passed into the brain at operation much as any ordinary ventricular canula would be manipulated, in the effort to locate subcortical lesions by the change from normal to abnormal brain wave patterns. A graph is obtained in very much the same way as in ordinary electroencephalography. Several case histories are recorded to demonstrate the usefulness of this little machine.

The greater immediate possibility of the procedure is the fact that it offers a method for the more thorough physiological exploration of the normal intact brain and its electrical activity in the various regions of a subcortical location less accessible to indirect electroencephalography. As the authors have pointed out, it may aid in the explanation of some of the incompletely understood phenomena of indirect electroencephalography.

JOHN MARTIN, M.D.

Freeman, W., and Watts, J. W.: Prefrontal Lobotomy. A Survey of 331 Cases. *Am. J. M. Sc.*, 1946, 211: 1.

The surgical treatment of certain types of mental disturbances is possible because of the demonstration that patients may survive and be apparently well despite the loss of a considerable portion of their prefrontal lobes. Its success rests upon the theoretical consideration that it interrupts long established synaptic pathways which have resulted in unsatisfactory emotional behavior. Results in the "best" cases show very little impairment of intelligence as measured by tests employed, and further inquiry into the functions of the prefrontal lobes was stimulated. Fundamentally, it is believed that the frontal lobes subserve the functions of foresight and insight, particularly as related to the self.

The authors conceive the psychosis in the terms of Egas Moniz; namely, the pathological stabilization of synaptic patterns among various cell groups, particularly in the frontal lobes. With the development of fixation of the psychosis, they suggest that there occurs, through the process of facilitation, the inclusion of a progressively larger number of cortical cell population into the pattern of behavior. They believe that the spread of the psychosis is in a posterior direction. At the present time they are inclined to the working hypothesis that the results of the operation depend upon the number of fibers severed in the anterior thalamic peduncle, and they endeavor to place the incisions so as to strike the proper balance between the abolition of the disaling psychosis and the preservation of the capacity for productive work. The more severe the psychosis and the longer it has been established, the farther back, and deeper, they make the incisions. The operative procedure for prefrontal lobotomy is briefly described.

Of the 331 cases subjected to this procedure, the authors report the results as follows:

Good, 52 per cent; fair, 32 per cent; poor, 13 per cent; and deaths, 3 per cent. Of the 266 living patients in June, 1945, who have survived from 6 months to 9 years, 30 are regularly employed, 8 are partly employed, 22 are keeping house, and 17 are in hospitals. The authors emphasize that the procedure should not be performed except in those cases in which more conservative procedures have failed, but that it should not be delayed until too much deterioration has occurred. The most favorable results have been obtained in obsessive tension states,

with or without compulsions, in hypochondriasis, intractable psychosomatic conditions, and in agitated depressions. Less satisfactory results are obtained in schizophrenias, although as long as the patient is fighting his disease there still remains the possibility of satisfactory modification of his behavior. Alcoholism, paranoid states, and psychoses with organic brain diseases yield rather poor results.

JOHN W. ERTON, M.D.

Turner, E. K.: Purulent Meningitis of Infancy and Childhood; A 12 Months' Survey of the Results of Treatment with Penicillin. *Med. J. Australia*, 1946, 1: 14.

The author summarizes her methods of treating purulent meningitis and the clinical results obtained in a series of 54 bacteriologically confirmed cases. There were 29 cases of meningococcal meningitis, 15 of pneumococcal meningitis, 7 of streptococcus hemolyticus meningitis, and 3 of staphylococcus aureus meningitis. The ages of the children ranged from 6 weeks to 12 years, the largest number being under 6 years of age.

The cases were divided into 2 groups on the basis of the acuteness and severity of the meningitis. When the clinical findings indicated a subacute form of the disease, the patients were treated entirely with the sulfonamide drugs unless an unsatisfactory clinical response necessitated the supplementary use or substitution of penicillin.

Sixteen patients treated only with sulfonamides recovered.

When the history and clinical findings indicated the presence of a hyperacute or fulminating meningococcal meningitis either with or without meningococcemia, the intrathecal administration of penicillin was employed. In this second group were also included those cases of pneumococcal, streptococcal, and staphylococcal meningitides. An initial dose of from 10 to 20,000 units of penicillin was administered by the intrathecal route upon establishment of the diagnosis and repeated once daily for an average of 4 days.

Penicillin was administered both intravenously and intramuscularly to control the meningococcemia. In addition, sulfonamides were given by mouth. Fourteen fulminant patients with meningococcal meningitis so treated recovered. Fifteen with pneumococcal meningitis were treated by the combination of intrathecal penicillin and oral sulfonamides, 8 recovered and 7 died. Of 7 with streptococcus hemolyticus meningitis so treated, 2 recovered and 5 died, and all 3 patients with staphylococcus aureus meningitis recovered.

The author believes that cases of fulminating meningococcal meningitis and other purulent types of meningitis demand the intrathecal administration of penicillin. It should be combined with oral administration of the sulfonamides. No toxic effects were observed in this series following the instillation of penicillin in the spinal cord.

LAURENCE M. WEINSTEIN, M.D.

## SPINAL CORD AND ITS COVERINGS

Ver Bruggen, A.: Extradural Spinal Hemorrhage. *Ann. Surg.*, 1946, 123: 154.

Very rarely a case of spinal cord injury is seen in which the onset of paraplegia is gradual over a period of a few hours. When the paraplegia is complete, a sensory level is also distinct. Operation at the site suggested by the level and the paraplegia may disclose a localized extradural spinal hemorrhage, the removal of which may lead to complete recovery. Although the author has been aware during the last 15 years that the possibility of such a case existed, he had never encountered one and on consulting the literature there was very little evidence that such a case had been encountered by anyone else except as a rarity.

The case was that of a 75 year old, white male with an old Marie-Struempell's disease of the spine, who fell on his buttocks from a height of 4 or 5 feet, and who during the course of the next 2 hours developed a paraplegia. Spinal puncture was impossible and roentgenograms revealed only Marie-Struempell's disease. The sensory level was over the hands and corresponded more or less to the sixth or seventh cervical segment. Operation was performed 6 hours after the injury and a localized extradural hemorrhage was discovered beneath the seventh cervical lamina posteriorly and in the midline. This clot measured 4 by 2 by 1 cm. Over the period of the next month the patient made rapid progress. The sensory level disappeared in 2 or 3 days and movements returned to the legs in 3 or 4 days. After 3 weeks, he was returned home, and after a period of a few more weeks he resumed his usual occupation and was apparently normal.

There is a short review of the English and American literature on this subject.

Asenjo, A., Contreras, M., and Espinoza, J.: Intraspinal Lipomas (Lipomas intraspiniales). *Arch. soc. cir. hosp.*, 1945, 15: 773.

The author was able to collect from the literature not more than 38 cases of spinal lipomas. Of 15 intraspinal tumors removed at the Central Institute for Neurosurgery and Neuropathology, Santiago, Chile, 2 were lipomas, one being intramedullary and the other extramedullary. Intrathecal, extradural lipomas were not considered. The extramedullary tumor was found in an infant 1 year of age. The very large tumor originating in the second cervical segment was removed, but the child died following the laminectomy. The intramedullary lipoma was found in a man aged 44 years. This patient recovered after the operation. In both cases signs of compression of the spinal cord were present.

While lipomas in the brain cannot be diagnosed, those in the spinal cord can be recognized because of symptoms of compression of the spinal cord. In the great majority of cases the lipoma is situated in the midline of the posterior aspect of the spine. The cervicothoracic region is most frequently involved.

There is a general consensus of opinion that lipomas are always of congenital origin. They frequently coexist with certain malformations, such as spina bifida, meningocele, meningomyelocele, and cutaneous lipomatosis.

Mycelography after lipiodol injection is of inestimable value in the diagnosis. JOSEPH K. NARAT, M.D.

### SYMPATHETIC NERVES

Fontaine, R., and Eck, F.: The Usefulness of Low Lumbar Sympathectomies in Surgery of the Obturator Nerve as an Auxiliary Method in the Treatment of Spastic Paraplegias in Pott's Disease (De l'utilité des sympathectomies lombaires basses accouées aux traitements des paraplegies spasmiques). *Rev. chir., Par.*, 1945, 64: 161.

Pott's disease with spastic paraplegia offers a much better prognosis than the flaccid type of case. Sympathectomy is valuable only in association with the basic orthopedic and medical treatment.

Surgery is indicated only when paraplegias persist after the general condition has become excellent and the sedimentation rate is nearly normal. Laminectomy and bone graft constitute the treatment of choice. The lower lumbar sympathectomy is preferable to the higher one as it can be easily combined with surgery of the obturator nerve. The surgery of the nerve consists either in crushing and alcohol injection or, in extreme spasm of the adductors, in resection of the nerve. WERNER M. SOLMITZ, M.D.

Crutcher, R. R.: Sympathectomy for Ischemia Following Femoral Artery Ligation. *Ann. Surg.*, 1946, 123: 304.

The author, apparently working in a general hospital in the Italian theater of war, discusses his experiences with 5 patients who had sustained transection of the superficial femoral artery below the profunda femoris branch.

One patient was returned to duty 3 months later suffering only from slight intermittent claudication. Three patients were subjected to lumbar sympathectomy 2 months after wounding because of persistent coolness of the affected foot, deficient acral arterial pulsations, and intermittent claudication on walking short distances due, the author believes, to persistent relative ischemia of the leg muscles. In all 3 patients the ability to walk without pain was improved, as were the color and warmth of the foot.

One patient had a lumbar sympathectomy performed at the time of the initial surgery and ligation of the femoral artery because the leg was cyanotic and pulseless. One wonders, however, in this case why procaine injection of the sympathetic chain was not performed instead of sympathectomy since the vascular phenomena appeared to be only an acute vasospasm associated with injury to the femoral artery.

In the 3 cases in which late sympathectomy was performed for persistent intermittent claudication, the clinical results were good and the patients evi-

dently benefited; at least the period of hospitalization was materially shortened.

Sympathectomy has a place in the late treatment of patients who present persistent vascular phenomena following injury of the major vessels.

LAURENCE M. WEINBERGER, M.D.

Southworth, J. L.: The Role of Sympathectomy in the Treatment of Immersion Foot and Frostbite. *N. England J. M.*, 1945, 233: 673.

The clinical syndrome of frostbite, and its more specialized form, immersion foot, which occurs after prolonged exposure in water, is of great military importance. Sixteen cases of immersion foot and 7 cases of frostbite from the U.S. Marine Hospitals at Staten Island, New York, and Savannah, Georgia, are presented.

Pathologically, changes begin with endothelial damage of the small vessels and proceed to tissue necrosis and nerve fiber degeneration. An important role is played by secondary infection. Many of the sequelae are caused by subsequent fibrosis.

Initially, analgesia and numbness of the extremity are manifest. With the return to a normal temperature, redness, edema, ecchymoses, pain, and bleb formation occur. Brownrigg has divided frostbite into first, second, and third degree types. Frostbite of the first degree is characterized by ecchymosis of the ankle and leg, hyperemia, and bleb formation; it follows a fairly mild course and leaves little or no disability. The second degree type superimposes some tissue death of the distal parts which may later require amputation. Seventy-five per cent of the patients have residual complaints of a neuritic or vasospastic nature plus the disability of the amputation. Third degree cases are those with gangrene of the deeper tissues, and amputation above the ankle is the rule. Later complications are rare except for the handicap resulting from amputation.

Early treatment consists of cooling the involved part. Sulfonamides and penicillin are given, as well as potassium permanganate soaks in cases in which dermatophytosis is present. When amputation is necessary, the author uses refrigeration anesthesia.

Late manifestations are disturbances in cutaneous sensation, inadequate circulation, and pain. The sensory changes range from anesthesia through all modalities, to dissociation of touch from pain and temperature. Near the area of anesthesia, hyperesthesia is present. Usually these symptoms disappear within from 3 to 12 months, but they may persist longer. Discomfort in walking, and frequently trophic, perforating ulcers secondary to other trauma but dependent on disturbed sensation, occur.

Inadequate circulation varies from case to case, according to factors at present obscure. This is manifested by hyperhidrosis and cold, wet, pallid feet which become cyanotic and mottled with exposure to cold. Less frequently intermittent claudication is present for a period. Sometimes in 12 to 18 months after the immersion foot or frostbite has



been sustained, the skin becomes thin, atrophic, red, and glistening. Fibrosis takes place with decreased agility of that part and amputation may be necessary. The chief disability of immersion foot is pain with walking. This is deep seated, dull, and aching. Often neuropsychiatric symptoms are precipitated by frostbite, and these may be more important and severe than those due to exposure to cold.

Repeated sympathetic blocks have been observed to hasten the healing of "civilian" frostbite and have no deleterious effects. The author's study is concerned with sympathectomy for the treatment of the sequelae of frostbite and immersion foot. Either the block or the surgical extirpation is recommended for the disturbance of cutaneous sensitivity and the circulatory insufficiency. Pain, which is often the chief complaint, is not benefited by sympathectomy, physiotherapy, or mechanical devices. Choice of the procedure — temporary block of the sympathetic chain, alcohol injection, or excision — depends on the severity of the symptoms.

Of the 23 patients presented, there were 6 first degree, 14 second degree, and 3 third degree types of frostbite. Symptoms had been present all the way from immediate possession to 27 years, this dating from World War I. Alcohol sympathetic injection was done in 9 cases, multiple procaine block in 4, and sympathectomy in 3 cases, 5 patients were treated with physiotherapy, and in 1 instance amputation alone was done. The patients receiving physiotherapy benefited little, or not at all. The others showed improvement, with 2 exceptions.

The Flathow approach is recommended for lumbar sympathectomy. When lumbar sympathetic alcohol injection is done, the author believes that one first lumbar ganglion should be spared—"to avoid dis-

turbances of the ejaculatory power." Care should be taken to avoid spearing any somatic nerves when injecting alcohol, to prevent subsequent paresis. This is managed by the use of a small amount of procaine in the skin and subcutaneous tissue, after reinstituting the needle at a different level until pain be experienced down the leg, in the leg, or at the genitals. Temporary block is given by 1 to 2 c.c. of procaine or metycaine; 4 c.c. of absolute alcohol is used for a more permanent block.

Thoracic sympathetic block is more difficult, and indications for operative sympathectomy should be more demanding than in the lumbar region. The first and second thoracic ganglia are anesthetized for therapeutic or diagnostic block of the sympathetic supply to the upper extremity. After the patient has been placed in the lateral or prone position, a wheel is made two fingerbreadths opposite the seventh cervical vertebra. A needle is inserted medially until the transverse process is met, then worked past its inferior border, and to the lateral aspect of the vertebral body. Aspiration is done to avoid subarachnoid injection. Five cubic centimeters of procaine or 4 c.c. of absolute alcohol are introduced when the needle is properly located. This is determined by the injection of 2 c.c. of procaine and if the needle is placed correctly, vasodilatation occurs. The same procedure is carried out opposite the next thoracic spine for T2. Since it is practically impossible to block the thoracic sympathetic ganglia without affecting the first and second thoracic nerves, these are deliberately injected when alcohol is used. Apical pneumothorax is possible when the pleura is pierced, but is not dangerous unless the patient is emphysematous.

C. FREDERICK KITTLE, M.D.

# SURGERY OF THE THORAX

## CHEST WALL AND BREAST

Bronstein, I. P., and Cassoria, E.: *Breast Enlargement in Pediatric Practice. Med. Clin. N. America*, 1946, 30: 121.

Breast enlargement in children has been defined as an involvement of the mammary tissues in which these structures simulate the size, the shape and, at times, the function of the adult female breast. The authors give the following classification of breast enlargement in childhood:

1. In the newborn
2. Preadolescent type
  - (a) Transient and persistent
  - (b) Pseudogynecomastia
3. Associated with obvious endocrinopathies
  - (a) Gynecomastia, hypogonadism, excessive urinary gonadotropin excretion
  - (b) Sexual precocity
  - (c) Addison's disease
  - (d) Tumors of the testes
  - (e) Thyroid affections
4. Artificially induced
  - (a) Gonadotropins
  - (b) Estrogens
  - (c) Testosterone
  - (d) Corticosterone
5. Miscellaneous
  - (a) Liver cirrhosis
  - (b) Leucemia
  - (c) Tumors (malignant, very rare)
  - (d) Massive involvement in girls
  - (e) Associated with atrophy of the testicle following orchitis and trauma

**Breast enlargement in the newborn.** A high percentage of newborn infants show some breast swelling by the fifth or sixth day. About two-thirds of these secrete a colostrumlike fluid followed, usually, by small amounts of milk. Instances of secretion persisting up to 12 months have been reported. These breasts are histologically miniature lactating glands attaining their development through the influence of placental transmission. The enlargement disappears spontaneously within a variable period. Treatment should not be attempted.

**Preadolescent breast enlargement.** Transient and persistent types occur in boys usually between the ages of 13 and 18, and in girls between the ages of 8 and 12 years. The swelling, either unilateral or bilateral, varying in size from 2 to 5 cm. in diameter, forms a roughly spherical tumor directly behind the nipple. Histological examination reveals an increased physiological hypertrophy of the pericanalicular and periacinar tissues similar to that observed after estrogenic administration. The course is not predictable. Some of the swellings disappear completely within a few weeks, others last for years. In

the persistent cases of breast enlargement in males, traced back to adolescence in which operation was done in young adulthood, the microscopic picture is similar to that found in chronic cystic mastitis in the female.

No instance of malignancy is reported in the patients with long-standing preadolescent breast enlargement. Most of these breast enlargements involute spontaneously within a few months. Surgical intervention may be advisable if there is no tendency to involution, and especially if personality changes become prominent.

**Pseudogynecomastia.** Breast enlargement in this condition, occurring in both girls and boys, is a part of the general picture of the obesity involving also the girdle and suprapubic areas. The involvement is bilateral, is unassociated with discomfort, and tends to assume the size and shape of the adult female breast. Gland tissue is not ascertainable, the swelling being apparently formed by adipose tissue. In the therapy of obese children, endocrine treatment did not cause any alteration in the redistribution of fat. With the general loss of weight the breast condition is also rectified.

**Breast enlargement associated with obvious endocrinopathies.** The syndrome of gynecomastia with small testes, aspermatogenesis, and excessive urinary gonadotropins has been noted in adolescent boys, and testosterone therapy was partially effective.

**Sexual precocity.** Breast enlargement may be one of the striking symptoms of sexual precocity. Instances of sexual precocity have been associated with a variety of conditions, i.e., hypothalamic lesions, osteodystrophia fibrosa disseminata, ovarian tumors, adrenal cortical tumors, and hyperplasia. Breast enlargement associated with Addison's disease, tumors of the testis, and thyroid affection is rare in childhood.

**Breast enlargement resulting from administration of hormones.** Chorionic gonadotropins have produced breast swellings when the material was administered for cryptorchidism. The doses administered in these conditions are not very great (3,500 to 7,000 rat units) and the breast enlargement, which is usually slight, disappears when the drug is discontinued.

**Estrogens.** Preadolescent girls with gonorrheal vaginitis treated with stilbestrol have developed breast enlargement which disappears with cessation of therapy. Oral stilbestrol therapy has been employed in male hypersexualism, and gynecomastia has appeared after the use of 375 mgm.

**Testosterone and Corticosterone.** Gynecomastia has been observed in some cases following the use of these substances.

Miscellaneous conditions associated with gynecomastia are rare, and have been enumerated in the classification.

ERNEST E. ARNHEIM, M.D.

Warren, S.: The Prognosis of Benign Lesions of the Female Breast. *Surgery*, 1916, 10: 32.

Although a large and as yet undetermined number of cancers of the breast appear to arise without antecedent pathological change, certain benign lesions predispose to the development of malignant mammary tumors. Some of these lesions have been almost universally regarded as precancerous, while some controversy has existed as to the significance of others. At least a portion of this uncertainty was based on confusion in terminology of the lesions. In any attempt to classify lesions of the breast certain points must be kept in mind.

1. Hypertrophy. At or following puberty, one or both breasts may enlarge to an excessive degree. The enlargement does not produce symptoms other than those referable to its size. The consistency is essentially that of a normal breast. On section the breast tissue is diffusely fibrotic with increase in the connective tissue elements and sometimes associated with periductal edema. Assays of the urine of these patients for estrogenic hormones usually show the estrogens to be within normal limits, although they may be slightly elevated. This condition does not predispose to the development of carcinoma.

2. Adenofibrosis. The breast with the lesion of adenofibrosis is diffusely fibrotic or finely nodular. In the early stages it shows cyclic swelling, more noticeable premenstrually and lessening with menstruation. Later, the slight to moderate increase in size becomes permanent. Pain is ordinarily more severe in the premenstrual period and is relieved by menstruation. The swelling and pain may be accompanied by venous engorgement. Study of the hormonal output has not revealed definite abnormalities. This condition rarely persists beyond the menopause; it is not known to be precancerous.

3. Chronic mastitis. The lesion of chronic mastitis is probably basically adenofibrosis with epithelial proliferation of a mild type or abnormal secretory activity of the mammary epithelium superimposed. There may be serous discharge from the nipple. On palpation, granular or nodular and, at times, firm cordlike structures may be felt, often radiating out from the region of the nipple. The nodules are not hard but somewhat elastic. At times the breast may reveal foci of closely packed, almost solid masses of ductal and acinar epithelium, which superficially resemble neoplasia. These foci are actually benign in spite of the somewhat bizarre and highly cellular picture that they may present. In its more marked forms, this condition, unlike adenofibrosis, may persist after the menopause. The lesion is probably due to endocrine dysfunction in which the normal cyclic character of the secretion of estrogens has been disturbed, and the process might be caused by continuous estrogenic stimulation lacking the counterbalance of an adequate production of corpus luteum hormone. In its milder forms this lesion is not precancerous, but in those in which marked epithelial hyperplasia occurs it must be considered precancerous.

4. Chronic cystic mastitis. This presents a number of forms. The one common factor is the development of cysts readily visible, single or multiple. They may have entirely lost their epithelial lining, the cavity lined with essentially normal epithelium, or they may be lined with epithelium showing various degrees of hyperplasia and intracystic papillary proliferation. Chronic cystic mastitis is most common toward the end of the childbearing period, just after the menopause. Adenofibrosis or chronic mastitis may precede the development of chronic cystic mastitis. Pain is usually absent. Cyclic swelling is not an integral part of the process. A lump in the breast, either localized or generalized, is the most clinically distinguishing feature. It cannot be clearly emphasized that given an isolated nodule in the breast, it is impossible to distinguish by physical examination between localized cystic disease and early carcinoma. The nature of such a lesion should be determined by biopsy. The presence of a typical blue domed cyst is no guarantee that the remainder of the breast tissue is normal and free from malignancy. On microscopic observation there may be found a single flattened layer of epithelium lining the cyst, or this may have atrophied and left fibrous tissue alone. There is every gradation from the atrophic lining through several layers of proliferating epithelial cells to the active proliferation of the duct with evidence of cellular anaplasia and mitotic activity, which lacks only the occurrence of the invasion to warrant the diagnosis of carcinoma. Since by external examination there is no way of distinguishing between those forms of chronic cystic mastitis which show little or no epithelial activity and those which show marked epithelial hyperplasia, the disease must be considered as precancerous.

On the basis of certain studies, the following general rule for the management of chronic cystic mastitis is presented. If the chronic mastitis is localized and the woman is under 35 years of age, it is particularly desirous of keeping her breast as long as possible without further therapy beyond the removal of the palpable mass is immediately indicated. Such a patient should be followed up at semiannual intervals and if a further mass develops, either a complete mastectomy or a radical mastectomy should be performed according to whether the mass is of firm, dense, or soft consistency. Since the lesions in chronic cystic mastitis and chronic cystic mastitis are apt to be bilateral, the logical procedure would be to remove both breasts. There is not sufficient proof of the subsequent development of carcinoma, however, to warrant or justify bilateral mastectomy. If the excision of a focus of chronic cystic mastitis or chronic mastitis, there is found evidence of benign precancerous hyperplasia, a complete mastectomy should be performed on the affected breast.

5. Intralobular papilloma. Intralobular papilloma of the breast is essentially a benign intralobular mass projecting into the distended lumen of a duct. The papillary mass is made up of completely benign

stromal bands often arranged in a frondlike pattern and usually attached at only one point to the wall of the duct. The epithelium is usually cuboidal, rarely columnar. The most common site is within 2 cm. below the areola, although it may be found elsewhere along the course of the ducts. The attachment of the intraductal papilloma is usually by a single stalk, although there may be several attachments. Since the stroma is quite vascular, oozing may occur from its blood vessels, and either bloodstained or frankly bloody discharge from the nipple may result. These tumors are rarely bilateral. Four types of papillary lesions are recognized: papillary hyperplasia in adenosis, papillary invaginations too small to be palpated but which produce bleeding at the nipple, benign intracystic papilloma, and papillary cancer. Excision of a grossly recognizable intraductal papilloma may leave others still present in the breast tissue. For this reason there is a predisposition to the subsequent development of carcinoma in a breast from which such a lesion has been excised. There is not a sufficient number of cases to permit any statement beyond the one that the occurrence of intraductal papilloma seems to predispose to the development of carcinoma in a breast and this lesion is more apt to predispose to the development of carcinoma than any other encountered in the breast.

6. Fibroadenoma. This is usually a single but sometimes multiple lesion of the breast, sharply circumscribed and freely movable. Usually spherical or ovoid, its contour may be slightly nodular. On exploration, the tumor is easily separated from the breast tissue. There is some evidence that these tumors are more frequent in nulliparous women with underdevelopment of the breasts. As has been frequently pointed out, a fibroadenoma which occurs in a woman near the menopause is somewhat more apt to become sarcomatous than one developing in a younger woman. Fortunately, adenofibrosarcoma is apt to be of low grade malignancy and rarely metastasizes to the regional nodes. Although local rather than radical mastectomy may be adequate therapy, the possibility of metastasis to axillary nodes must be kept in mind. Fibroadenoma of the breast does not predispose to the development of mammary carcinoma.

STEPHEN A. ZIEMAN, M.D.

#### Shimkin, M. B.: The Experimental Induction of Mammary Cancer. *Surgery*, 1946, 19: 1.

Studies on the genesis of mammary tumors of mice indicate that the neoplastic reaction is the end result of an intricate interplay of at least four factors or complexes of factors:

1. The genetic constitution of the mouse influences mammary tumor development by determining the susceptibility of the mammary tissue to the hormones and the milk agent by modifying or altering the mechanism of hormonal stimuli, and by determining the animal's resistance to the milk agent and its transmission. Genetic factors influencing this susceptibility are multiple. The ability of the animal

to propagate the milk agent and susceptibility to mammary cancer may be governed by a separate set of genes.

2. Hormonal stimuli are essential for the development of the breast and for the creation of a suitable substrate for the action and interaction of other factors that eventuate in the development of mammary tumors. There is no evidence that the hormonal complex must be abnormal, either qualitatively or quantitatively, for the genesis of mammary tumors in mice. Alterations induced in the hormonal balance by the addition or withdrawal of estrogens and other hormones modify the processes that lead to the development of tumors.

3. The milk agent, transmitted through the milk of the mother, is necessary for the appearance of most of the mammary tumors in mice. The virus nature of this agent is not established. However, if it is a virus, the appearance of mammary tumors would be influenced by variations in the virulence of the agent under various conditions.

4. Various other environmental factors, such as diet, temperature, and overcrowding, also affect the genesis of mammary tumors, probably by modifying the growth and development of the tissues and of the hormonal secretions of the animal.

There is no evidence in the literature to prove that even protracted use of estrogenic substances has been instrumental in producing mammary carcinoma in women. The possibility of carcinogenesis due to the protracted use of these agents cannot be overlooked however, nor the danger of using such preparations for the treatment of breast masses diagnosed clinically as benign, which leads to procrastination in surgical intervention for possible early carcinoma.

Cystic disease and other benign masses of the breast in women increase the risk of carcinoma.

In all species, a degree of genetic susceptibility and a degree of hormonal stimulation are essential for the development of cancer of the breast. The process can be modified by numerous secondary factors of internal and external environment. Although it is possible that the fundamental mechanism of transformation of normal cells to malignant neoplasms is the same for all types of cells and all species of animals, the inciting factor leading to the development of the malignant state are obviously different for different types of neoplasia and different species of animals.

It is possible that not all mammary cancers in one species can be grouped etiologically. For example, it is not established that the mammary cancers of mice in which the milk agent is operative are the same as those induced by methylcholanthrene.

Extrapolation from one species to another and from one type of tumor to another is not warranted at this early stage in the knowledge of the nature of neoplastic reaction. It is sounder to accentuate the careful, patient analysis of each possibly divergent type of cancer, with the hope that eventually this information may be synthesized into a coherent whole.

SAMUEL K. KARY, M.D.

Foot, F. W., Jr., and Stewart, F. W.: A Histological Classification of Carcinoma of the Breast. *Surgery*, 1946, 19: 74.

In the classification scheme offered by the authors, carcinoma of the breast has been classified, in so far as possible, as to site of origin and, hence, the nipple has been taken as a starting point, followed by the ducts and lobules, and, finally, certain relatively rare or highly unusual histological types of cancer have been enumerated. Certain forms of mammary cancer such as carcinoma en cuirasse and inflammatory carcinoma are omitted as they do not have histological specificity.

Histological classification of carcinomas of the breast:

1. Paget's disease of the nipple
2. Carcinomas of the mammary ducts
  - a. Noninfiltrating tumors
    1. Papillary carcinoma
    2. Comedocarcinoma
  - b. Infiltrating tumors
    1. Papillary carcinoma
    2. Comedocarcinoma
    3. Carcinoma with productive fibrosis
    4. Medullary carcinoma
    5. Colloid carcinoma
3. Carcinomas of the mammary lobules
  - a. Noninfiltrating
  - b. Infiltrating
4. Relatively Rare Carcinomas
  - a. So-called sweat gland carcinoma
  - b. Intracystic carcinoma
  - c. Spindle cell carcinoma, "adenosarcoma"
  - d. Adenoid cystic carcinoma
  - e. Carcinoma with osseous and cartilaginous metaplasia
  - f. Squamous carcinoma
  - g. Malignant variant of fibroadenoma and cystosarcoma phyllodes

The clinical implications of Paget's disease of the nipple are, for the vast majority of cases, quite clear cut and they indicate the necessity for radical amputation of the breast. Even in Paget's disease of the nipple, in which there is no clinically palpable underlying lesion, one undertakes considerable responsibility when recommending any procedure short of radical mastectomy. Metastases have been found in Paget's disease when no definitive tumor was palpable. Sections from such cases have shown the presence of miniature infiltrating carcinoma.

It is very difficult in some cases to be certain from frozen sections that there is no infiltration in non-infiltrating papillary carcinomas. Under these circumstances the authors recommend simple mastectomies. If no infiltration is found after study of subsequent paraffin sections, further operative procedure is unnecessary. If, however, the tumor is shown to be infiltrating, it is obligatory that radical dissection be carried out.

A true noninfiltrating comedocarcinoma represents another example of breast carcinoma which may be rationally treated by simple mastectomy.

The practice of aspiration biopsy obviates any delay in the correct diagnosis of infiltrating papillary carcinoma. In those cases in which local excision is done, the gross aspect or, if needed, frozen section will disclose the true nature of the tumor, and the radical operation can then be carried out. Conservatism is unwarranted in spite of the better prognostic outlook.

Tumors comprising the group of infiltrating duct carcinomas with productive fibrosis are far and away the most common forms of mammary cancer, aggregating roughly 70 per cent. Included here are the tumors that may be summed up as the "ordinary mammary scirrhus." The macroscopic characteristics of these tumors are easily recognized, and these are the forms of mammary carcinoma usually described when the classical gross traits of mammary carcinoma are enumerated. The majority of these tumors are not rounded, but are discoid and have distinctly irregular edges which radiate from the general periphery of the tumor into the adjacent fibrous or fatty breast tissue. An outstanding attribute is firm and almost unyielding induration. Radical mastectomy is the only approved surgical procedure for tumors of this infiltrating group.

Grossly, medullary carcinomas have highly distinguishing qualities. They are commonly quite bulky, measuring 4, 5 and 6 cm. in diameter, and now and then these dimensions are doubled. They are rounded or globoid, may be cut with little resistance, and although not encapsulated they are distinctly circumscribed and present a smooth periphery. As a rule the axillary nodes do not contain tumor unless the primary growth is as large as from 1.5 to 2 cm., and the tumors may reach a very large size even fungate without having metastasized to the axilla. They constitute from 15 to 20 per cent of the breast carcinomas. In surgical control of this disease, radical mastectomy is again the only procedure that can be properly advised.

Lobular mammary carcinoma *in situ* cannot be diagnosed clinically, nor can a diagnosis be made on gross pathological examination. For this reason, this form of noninfiltrating carcinoma represents an incidental finding in local excisions which have been done for presumably benign conditions. The only physical sign elicited when this lesion exists is a defined induration, and this only in the exceptionally well developed case. Simple mastectomy should be done when the diagnosis of lobular carcinoma *in situ* is made, and if, in subsequent pathological material, infiltration is discovered, further surgical procedure is necessary.

Infiltrating lobular tumors make up from 5 to 10 per cent of all breast carcinomas. Infiltrating lobular carcinomas are more apt to resemble scirrhus carcinomas than any other gross anatomic type. The tumors, as a rule, are discoid or somewhat irregular in shape and are rather poorly demarcated. They are tough and firm, but are less apt to show the chalky streaks so common in the ordinary mammary scirrhus. These tumors are fully aggressive and

mary cancers and as such call for radical surgical measures.

There are no unique characters that make it possible to identify so called sweat gland carcinomas. Ordinarily they resemble the more cellular infiltrating duct carcinomas with more or less productive fibrosis. The therapeutic implications of infiltrating mammary carcinomas apply here. If perchance a noninfiltrating form is encountered, simple mastectomy should suffice.

If the malignant alteration of a fibroadenoma is met with in an early phase, and is confined to the lining epithelium, or at most not extending beyond the capsule, the disease can be controlled by local excision or simple mastectomy, in accord with the extent of the change. With infiltration radical mastectomy becomes necessary.

JOSEPH K. NARAT, M.D.

**Harrington, S. W.: Survival Rates of Radical Mastectomy for Unilateral and Bilateral Carcinoma of the Breast. *Surgery*, 1946, 19: 154.**

The mammary gland is one of the most common sites of malignant disease in women. There are essentially two types of primary malignant neoplasm of the breast, carcinoma and sarcoma. The former is the principal type of malignant lesion occurring in the mammary gland.

Statistical studies have been made on all patients on whom radical operation has been performed at the Mayo Clinic for malignant disease of the breast from the years 1910 to 1940, inclusive; they comprise a series of 6,558 cases. Forty-seven patients (0.7 per cent) died in the hospital following operation; and of the 6,511 patients who recovered from the operation, 6,318 (97.0 per cent) were traced for 3 or more years.

These studies have been made primarily to determine the results of radical surgical treatment as well as to point out some of the clinical or pathological factors that influence the prognosis. In all of the statistical studies of survival rates it has been assumed that the patient died of malignant disease, although in many instances it was definitely known that death was due to other causes.

The first study in detail was made on the entire series of malignant lesions of the breast treated by radical mastectomy from 1910 to 1940, inclusive. All cases were included: those of carcinoma, sarcoma, unilateral and bilateral disease, and females and males. The objective of this study was to determine the influence that the extent of the disease, as indicated by the presence of axillary nodal metastasis when found at the time of the operation, had on the prognosis.

There was a wide variation in the survival results and the prognosis was much better in the cases in which axillary nodal metastasis was not found at the time of operation than in the cases in which axillary nodal metastasis was found. The patients who did not have axillary metastasis at the time of operation constituted 40 per cent of the entire series. The

proportion of this group of patients living 3 years or more after operation is 85.0 per cent or almost twice as large as that of the group with axillary metastasis which was 45.3 per cent. In the 5, 10, 15, and 20 year survival rates of patients without axillary nodal metastasis, it is found that the improvement increases progressively over the group with axillary metastasis. For the 5 year period, the survival rate for the group without metastasis is two and a half times as large as that for the group with metastasis; for the 10 year period it is three and a half times as large; for the 15 year period it is four times as large and for the 20 year period it is more than five times as large.

Studies of survival rates in special groups such as of carcinoma, sarcoma, unilateral and bilateral disease, and males and females were all included in the complete article. All of the different classifications and types of carcinoma were divided into two groups, those in which axillary nodal metastasis was present and those in which it was not present at the time of operation.

**Adair, F. E., and Herrmann, J. B.: Sarcoma of the Breast. *Surgery*, 1946, 19: 55.**

From 1926 to 1944, inclusive, 5,499 examples of malignant breast tumor were seen at the Memorial Hospital, New York, New York. Of these, 30, or 0.5 per cent, were sarcomas. The higher percentage of sarcoma found by the earlier investigators may possibly be due to the inclusion of some small round cell and spindle cell neoplasms which were formerly classified as sarcomas but were in all probability atypical carcinomas.

Among the 30 sarcomas the following types were encountered: cystosarcoma phyllodes (malignant), adenosarcoma, fibrosarcoma, spindle cell sarcoma, angiosarcoma, liposarcoma, lymphosarcoma, Hodgkin's sarcoma, carcinosarcoma, and myosarcoma.

It is accepted by numerous investigators that many sarcomas and an occasional carcinoma may arise on the basis of a previously existent fibroadenoma. In the course of development of some sarcomas, the connective tissue elements may obliterate the epithelial components and produce an almost pure sarcoma such as the fibrous and spindle cell varieties. In others the epithelial elements may persist and both structures may manifest malignant characteristics, as in cystosarcoma phyllodes and adenosarcoma.

The diagnosis of breast sarcoma in most instances necessitates the differentiation of this condition from cyst or carcinoma. The history is frequently suggestive of sarcoma. In these instances the patient states that a tumor has been present, although quiescent, for a considerable length of time. Suddenly it begins to increase rapidly in size. This occasionally follows a trauma. A cyst may exhibit the same phenomena although in the latter condition there is rarely the history of a pre-existent tumor. The spherical, cystic property of the mass and its capacity to transilluminate suggest that the tumor

may be a cyst. Sarcoma is not translucent except in those forms of *cystosarcoma phylloides* which are more cystic than solid.

Carcinoma may be suspected if there is skin dimpling or nipple retraction. These are seldom observed in sarcoma unless the tumor becomes so large that it impinges on the overlying skin. Then it may produce attachment, redness, and ulceration. Occasionally a diffuse duct carcinoma may produce great enlargement of the breast and in this respect simulate sarcoma. However, the diagnosis of sarcoma may be difficult or impossible to establish by clinical means. Aspiration biopsy in most instances will furnish the requisite information.

Sarcomas are usually very vascular. There is metastasis to distant organs in from 12 to 18 per cent of the cases. In order of frequency these organs are the lungs, liver, brain, dura mater, pleura, the mediastinal, retroperitoneal, and axillary nodes, the heart, kidney, and bones. Despite an apparent cure of a breast sarcoma it is possible for a metastatic focus to appear after many years. This, however, is an unusual phenomenon. Lymphatic channels have not been described in sarcoma. For this reason the lymphatic spread of the disease with invasion of the lymph nodes, except in lymphosarcoma, melanosarcoma, and carcinosarcoma, is necessarily a rare phenomenon. Although axillary and supraclavicular lymph nodes may be palpable, the enlargement in most instances is the result of an inflammatory rather than a metastatic process. In the authors' series 4 patients had palpable axillary nodes. A study of 100 radical mastectomies for sarcoma collected from the literature reveals lymph node invasion in 4 per cent.

An analysis of the results of surgical therapy would indicate that conservative procedures are as effective as radical measures. Since there is evidence that breast sarcoma owes its inception in some instances to malignant deviation of a fibroadenoma, this tumor should be removed early. Early removal is also the best method for preventing metastatic spread if sarcomatous change has already occurred. If the tumor is small and of low grade malignancy, simple excision should suffice. If larger or of a higher degree of malignancy, a simple mastectomy with removal of the pectoral fascia is indicated. The more malignant forms have the tendency to infiltrate the underlying muscle and give rise to recurrences. For that reason, in situations where there is evidence of this possibility the pectoralis major muscle should be removed. Radical mastectomy is the procedure of choice in primary lymphosarcoma, melanosarcoma, and carcinosarcoma.

Since breast sarcoma is an unusual lesion there has been relatively little opportunity to determine the therapeutic effect of irradiation on these tumors. Postoperative x-ray treatment may be of value in very cellular tumors and in those which manifest infiltrative tendencies. There is also a possibility that the vessels adjacent to the excised tumor or breast tumor may contain tumor thrombi. Under

these circumstances radiation therapy might prove advantageous. It is quite possible that in some forms of breast sarcoma the incidence of recurrence and metastasis may be materially decreased by irradiation. Until enough data have been accumulated, a definite conclusion cannot be reached.

The prognosis is dependent upon the type of the neoplasm. Sarcoma is a generic term for a number of new growths which have in common their origin from mesodermal elements. These tumors vary in their malignant potentialities. At one end of the scale is the low grade malignant variant of *cystosarcoma phylloides*, and at the opposite extreme is the highly malignant angiosarcoma. This classification is subject to further division because there are variations in degree of malignancy within the groups. Thus, the prognosis depends not only on the type of sarcoma but also on the grade of the particular lesion within the group.

Age is also a factor. Sarcoma tends to occur in relatively young women. Sarcoma occurring in a functionally active breast evinces a morbid disposition to recur after operation with less disposition to metastasize, whereas a sarcoma of the declining breast recurs less frequently but metastasizes in a greater number of instances. This generalization does not appear to apply to angiosarcoma.

Local recurrence, regardless of the surgical procedure employed, is a frequent occurrence but does not necessarily imply a poor prognosis.

It has been frequently stated that sarcoma of the breast offers a better prognosis than carcinoma of this organ. This depends upon the variety and grade of the sarcoma. Certainly angiosarcoma is much more malignant than most cancers and, conversely, low grade fibrosarcoma and liposarcoma are much less malignant than low grade carcinoma.

JOSEPH K. NARAT, M.D.

### TRACHEA, LUNGS, AND PLEURA

Rousseau, R. G., Abat, O. D., and Medrano, F. A.: Primary Epithelioma of the Trachea (Epithelioma primitivo de la tráquea). *Arch. cubano cancerol.*, 1945, 4, 275

The authors present a brief review of the literature and a report of 4 cases, 1 having been seen by them recently, 1 studied 6 years before, and 2 seen by other local physicians.

The first tracheal neoplasm was probably recognized in 1767, and in 1871 Langhans described the first case of primary tracheal epithelial neoplasm. Collected series of neoplasms reveal a low percentage incidence in the trachea. When compared to laryngeal neoplasms, the incidence is variously reported as 3 to 748; 4 cancers of the trachea to 800 of the larynx, or 2 epithelial tumors of the trachea to 517 of the larynx. According to Chiari, cancer is the most frequent of the primary tracheal neoplasms.

The distribution of tracheal tumors is roughly 50 per cent in the lower third, 35 per cent in the upper third, and 15 per cent in the middle third.

Men are more often affected than women, in a 2 to 1 proportion. The age group most frequently involved is between 50 and 70 years.

The symptoms are cough, sometimes productive of blood and dyspnea. Dysphonia is sometimes noted, probably as a result of mediastinal invasion, which is common and involves the recurrent laryngeal nerves.

Diagnosis is made only by tracheoscopy and biopsy. Indirect laryngoscopy may permit visualization of some of the neoplasms. Bronchography may give suggestive evidence. The prognosis is unfavorable and life expectancy ranges from 6 to 18 months.

Treatment has consisted in excision with or without electrocoagulation, performed endoscopically or by open operation resection or repeated cauterization. Radium has been used. The authors used deep roentgen therapy in 2 of the cases reported. Electroexcision and radium are suggested as therapeutic methods. Photomicrographs of a tumor and a reproduction of a bronchogram are appended.

A list of 85 references to the literature is given.

HIRAM T. LANGSTON, M.D.

Brewer, L. A., Burbank, B., Samson, P. C., and Schiff, C. A.: The "Wet Lung" in War Casualties. *Ann. Surg.*, 1946, 123: 343.

By "wet lung" is meant the persistence of fluid in the pulmonary tree. Since this is a very important problem in the care of the wounded, and since no reference to the problem is seen in prior literature, the authors believe that a discussion is warranted. The observations presented are based on the care of over 700 chest casualties, and the thoracic complications in over 3,000 other casualties during the Sicilian and Italian campaigns.

Two groups of factors are important in the development of the wet lung. Those in the first group are referred to as forces leading to the production of secretions or other fluids in abnormal amounts in the respiratory tract. These include (a) mucoid secretions derived from increased secretory activity of the bronchial mucosa; chest wall trauma frequently has been shown to result in widespread bronchial spasm and increased bronchial secretion; other elements such as traction on the cystic duct or mesentery may do the same; (b) blood from intrapulmonary hemorrhage is present; (c) mucopurulent secretions resulting from respiratory infections in men who have undergone the exposure of combat conditions are common; (d) fluid arises from the alveoli of the lung.

The mechanism of this production in the severely wounded is not clear, but at least four factors contribute to it: (1) pulmonary trauma, (2) increased respiratory effort, (3) tracheal obstruction, and (4) anoxia. The effects of "blast" and a late manifestation of shock may also contribute.

Other important factors in the development of the wet lung are conditions preventing adequate removal of the fluids produced. These include factors interfering with the proper functioning of the cough

mechanism, such as chest pain or abdominal pain. Rib fractures are a potent source of chest pain. Multiple fractures resulting in a "flail chest" add the factor of paradoxical motion. Caution against overdosage of morphine is stressed. Coma or unconsciousness, and prolonged anesthesia or delayed reaction of the patient are discussed. The position of the patient because of pain may favor gravitation and retention of secretions.

Early harmful effects of this condition are the improper ventilation and aggravation or production of anoxia. Plugging of branches of the bronchial tree lead to atelectasis and its attendant disturbances. Later, if the patient recovers from the primary shock and the pulmonary tree is not cleared, atelectasis, pneumonia, and tracheobronchitis are likely to follow.

The signs and symptoms of the condition should be recognized as soon as possible, and active treatment instituted. They include a "wet cough," and a wheezing or rattling quality to the cough may persist even though sputum is actually being raised by the effort. The cough may be continuous and hacking or paroxysmal. Occasionally it may even be nonproductive. Persistence of rales after coughing indicates inadequate expulsion. Dyspnea, particularly if out of proportion to the extent of trauma or pleural accumulation, is important. The post-tussive rale may vary from a high pitched wheeze to bubbling. The "oral click" is a sensitive index of moisture in the tracheobronchial tree. Tachycardia, cyanosis, more or less shock, and even coma may be present, as well as psychotic manifestations. The character of the sputum may be of diagnostic value; if mucoid, it suggests reflex bronchial stimulation, irritation by aspirated material, or early infection; hemoptysis means pulmonary injury; thin sero-sanguineous or seropurulent material suggests a bronchopleural fistula; a frothy appearance favors pulmonary edema.

The x-ray picture is not definite in the earlier stages, and may be confused with pulmonary hematoma and other conditions. Established atelectasis is, of course, definitely recognized.

Treatment begins with prevention. All cases of thoracic, abdominal, or brain injury are surveyed from this standpoint. Fowler's position is recommended for better aeration of the lungs and to prevent encroachment on the thorax by abdominal viscera. Oxygen is used as indicated and the patient is assisted in coughing. Morphine is cautiously used, preferably intravenously, since its effects can thus be better gauged. Aspiration of any pleural accumulation, sealing of sucking wounds, and relief of gastric distention are added to the usual resuscitative measures.

Active treatment consists in:

1. Intercostal nerve block for the relief of pain. The technique is briefly described. Several segments should be blocked on either side of the injured area. The benefits of this last longer than the pharmacological action of the drug, although the explanation



is not clear. Strapping, except to stabilize a "flail chest," is not necessary. Intercostal block may be beneficial beyond mere relief of pain, in interrupting reflexes which presumably result in bronchospasm and bronchorrhea. Intercostal block at the end of thoracotomy is a means of reducing postoperative pain and complications.

2. Catheter aspiration. If the patient is unable to adequately clear the tracheobronchial tree by conservative means, some mechanical method of accomplishing this is necessary. The technique of passing a catheter into the trachea and electively into either bronchus is described. The catheter produces coughing and expulsion of secretions, in addition to the amounts aspirated. In some instances, it may be left inlying and oxygen may even be given by this method. The method is effective, readily available, does not require extensive experience, or the use of a complicated apparatus.

3. Bronchoscopy. This is used when catheter suction is not sufficiently effective or when a more thorough cleansing of the tracheobronchial tree is required, such as in established or suspected atelectasis. It should be done neatly and with dispatch to prevent undue fatigue. Oxygen may be administered during this procedure.

4. Positive pressure oxygen. The constant formation of fluid in the alveoli and branches of the bronchial tree by transudation, as in pulmonary edema, cannot be satisfactorily removed by the methods listed. This method is satisfactory in retarding or preventing this phenomenon, but all accumulations from other sources and the excesses from this source should be eliminated prior to its exhibition. Positive pressure oxygen is administered from a to-and-fro system containing a soda lime canister and rebreathing bag. Pressure is maintained manually and should be kept below 10 cm. of water. The method is probably not safe for cases of severe shock, as it may seriously impede the return flow of blood to the heart.

Four illustrative case records substantiated by good roentgenograms are presented. The available experimental evidence supporting the views which have been expressed, is discussed.

HERMAN T. LANGSTON, M.D.

**Bobrowitz, I. D., Edlin, J. S., Bassin, S., and Woolley J. S.: Penicillin in the Treatment of Bronchiectasis. *N. Eng. J. Med.*, 1946, 234: 141.**

The present study was made to estimate the advantages of the topical or bronchial effect of penicillin in the treatment of bronchiectasis when administered intramuscularly, intratracheally, intrabronchially, and by inhalation (nebulization), singly or in combination.

Ten men and 2 women from 16 to 30 years of age were treated from August 9, 1944 to April 18, 1945, the first 9 at the municipal Sanatorium, Otisville, New York, and the last 3 at St. Clare's Hospital, New York, New York. The follow-up observations were made at the St. Clare Clinic.

Assay studies showed a lack of penicillin in the sputum of patients following intramuscular injection. Daily intratracheal instillations for more than a short period were found to be definitely undesirable.

The intratracheal route gives the most effective local concentration of the drug, an excellent topical or bronchial effect, and a good parenchymal effect with a high absorption rate, as indicated by high blood and urine levels. A short intensive course with intratracheal instillations of at least 100,000 units daily by the supraglottic method, with topical cocaine and postural control, is suggested as suitable for preoperative preparation for lung resection. It can also provide an immediate maximum and rapid effect prior to continuation of the penicillin by inhalation, which is the simplest procedure although more drug must be used (4,000,000 units in 60 days give an optimum average sputum penicillin concentration of 86 units per cubic centimeter). Excesses are lost in the sputum.

Penicillin inhalation is not necessarily a hospital procedure. It may be resorted to in the physician's office, the clinic, or the patient's home with a vaporizer and oxygen tank. There are no evidences of toxicity over a long period of time. It is advisable to assay routinely the sensitivity of bacteria from infected foci of all patients to whom it is contemplated to administer penicillin. The question of the resistance of organisms is still unsettled and its relationship to therapy is yet to be determined.

Although destructive changes of bronchiectasis are irreversible, the present series, which includes patients who could not be treated surgically because of multilobar and bilateral involvement, shows that treatment with penicillin causes diminution of the sputum, elimination of gram positive organisms, favorable influence on gram negative organisms, clearing of foul odor, reduction in purulence, and beneficial effects on cough, dyspnea, wheezing, anorexia, weight, and nasal discharge. With cessation of therapy, cough and expectoration increased, organisms reappeared, pus cells became more numerous, and in many cases odor returned; however, the sputum level was one-half that of the original and much of the symptomatic improvement persisted.

If treatment could be prolonged with sustained effectiveness this nonoperative method might control such complications as pneumonia, lung abscess, empyema, amyloidosis, cardiac failure, and brain abscess, as well as the psychic, social, economic, and physical handicaps of bronchiectasis. Sufficient dosage for a long enough period might even lead to repair.

Prior to penicillin administration and throughout the hospitalization period, patients were kept on postural drainage 2 or 3 times a day for from 10 to 15 minutes and were instructed to continue it after discharge. Diagnosis was established by means of the bronchogram with lipiodol. Sputum was regularly measured or weighed, the odor noted, and the

presence, relative number, and kinds of organisms were noted by smear and confirmed by culture, both aerobic and anaerobic. The symptoms and physical findings were characteristic. Two cases gave roentgenographic evidence of sinus involvement.

LYNN JOHNSON, M.D.

Brown, C. J. O.: *Putrid Lung Abscess. Med. J. Australia*, 1946, 1: 107.

Putrid lung abscess is a serious and by no means infrequent complication of surgical operations and parturition. Of 41 patients operated on for lung abscesses, 21 acquired the lesion following operation or parturition.

The common factor in all 21 was general anesthesia; in most cases the anesthesia was "troublesome," or postoperative vomiting occurred. Some patients had recovered too soon from anesthesia in a dental operation, and anesthesia was reintroduced when the patient had his mouth full of blood and saliva. In one instance, teeth and tonsils, and in another tonsils and antra, were dealt with at the same operation. In yet another, although the patient was not seen to vomit, some dried vomitus was noticed on the pillow. Postoperative lung abscesses result from the inhalation of blood, pus, or debris, and it can be shown by bronchoscopy that some blood always enters the trachea during any operation on the nose or mouth unless special measures are taken to prevent it. Even in a conscious patient the laryngeal reflex is not the complete protection it is often assumed to be. Lipiodol introduced into the pharynx of a sleeping patient can be demonstrated roentgenologically in the lungs next morning, and heavy sedation is quite sufficient to put the laryngeal reflex off its guard.

If the patient is lying on his back, inhaled material tends to gravitate into the bronchus to the apex of a lower lobe—usually in the right lung—and if he is lying on his side, it flows first into the upper lobe bronchus of the lower lung. These facts can readily be demonstrated with lipiodol under the x-ray screen. Postoperative abscesses are most common in the apices of the lower lobes and in the upper lobes. After regional block anesthesia inhalation may occur while the patient is "sleeping it off," and heavy sedation should be avoided in these patients.

The blood aspirated into the lungs after the majority of mouth and nose operations, is coughed up and causes no trouble. In some a small bronchus becomes blocked by the inhaled material, and the corresponding segment of lung becomes atelectatic; with infection added, a localized pneumonitis develops, and this is the explanation of many postoperative pneumonias. When the infecting organisms are necrotizing dental anaerobes or similar types, a putrid lung abscess results. The segment of atelectatic lung always abuts on the visceral pleura, infection excites an intense pleural reaction and adhesions form over the area of reaction. Since the greater part of the surface of the lung is in contact with the chest wall, in most cases these adhesions fix the site of the abscess to the chest wall. This does

not happen if the abscess reaches the pleura on the diaphragmatic or mediastinal surfaces of the lung, or in a fissure. In all other cases there is an area of adhesions through which the abscess can be drained without opening of the free pleural space. This area is sealed off early and the adhesions are firm within 2 or 3 weeks of the onset of the abscess. The area of fusion may be limited and is often not more than an inch or two in any direction; but with accurate localization it is usually adequate for approach to the abscess.

Cavitation always occurs in from 7 to 10 days from the onset, and in acute abscesses the cavity is found to average about 2 inches in diameter, and is solitary, spherical, and unilocular. It contains pus, debris, and sloughs, and after a few days opens into a bronchus; this allows the exit of the foul gases which cause the putrid smell and taste, even before any pus is evacuated. As the bronchial opening enlarges, pus and sloughs may be evacuated and spontaneous cure may result.

In most instances bronchial drainage is inadequate and the process tends to become subacute. Fibrosis develops in the walls of the abscess and in the adjacent lung, local extensions occur and cause multiloculation, and "spillover" into the adjacent bronchi results in satellite abscesses and bronchiectasis. At this stage drainage is useless, and the only hope of cure is by extirpation of the diseased portion of the lung. At any stage the abscess may perforate into the pleural cavity and produce a localized or generalized pyopneumothorax. Cerebral abscesses may result from blood spread, and amyloid disease may develop from long continued suppuration. "Spillover" into other parts of the lung may cause suppurative pneumonia or other abscesses. Acute, subacute, and chronic stages shade into one another; but it is helpful to separate them arbitrarily. For practical purposes an abscess less than 6 weeks old is acute; from 6 weeks to 3 months it may be considered subacute; and after 3 months it is considered chronic.

Symptoms are fairly constant. After operation there is usually an incubation period of a few days, followed by the onset of illness with flushes, chilliness, and rigors. Pain in the chest indicates the site of pleural involvement, and localized tenderness may be elicited over this area. A cough develops, and although at first it is dry, irritating, and nonproductive, in a short time—usually in 10 or 12 days from the onset—the patient begins to expectorate foul pus in increasing amounts. Some days before expectoration commences a foul odor may be noticed in the breath, and this is diagnostic of the presence of a lung abscess. Hemoptysis frequently occurs. The maximal interval between operation and onset is probably 14 days.

Prophylaxis includes carefully planned administration of an anesthetic. In operations of the mouth or throat in which it is likely that aspiration will occur, the anesthetic should be administered through an endotracheal tube and the pharynx should be packed or otherwise shut off. In any

operation, if aspiration does occur or is suspected, the air passages should be cleared at the end of operation by tracheal suction or bronchoscopy, and if atelectasis develops in the postoperative period, active measures should be taken to overcome it. The patient should be given morphine, laid on the sound side and vigorously thumped and rolled about. This may start a fit of coughing with the expulsion of a plug of mucus or blood clot, which will be followed by re-expansion of the collapsed area. If it fails, tracheal suction with a catheter may be tried or bronchoscopy may be used.

No operation of election should be performed in the presence of dental infection, and dental inspection should be a routine measure before operation in all hospitals.

Management of acute abscesses requires early surgical drainage in most instances, but once the condition of chronic pulmonary suppuration has been reached, although drainage may bring about some improvement, cure is rarely possible except by extirpation.

Probably 30 per cent of putrid abscesses resolve spontaneously and it is reasonable to be conservative for a few weeks in cases in which abscesses are apparently draining well into a bronchus, the course is not very acute, and the cavity is only moderate in size. Unless resolution is progressing satisfactorily, drainage should never be delayed beyond 6 weeks, and if symptoms recur after apparent resolution the abscess should be drained without further delay.

Sulfonamides are useless for putrid infections. Penicillin, however, is efficient in controlling them, provided drainage is adequate; but it is useless without effective drainage. STEPHEN A. ZIEMAN, M.D.

Evans, T. S., Swirsky, M. Y., and Chernoff, H. M.: Primary Endothelioma of the Pleura; Report of a Case in a Patient with Chronic Lymphatic Leucemia. *Ann. Int. Med.*, 1946, 24: 262.

This case report of a 40 year old white female from Grace Hospital, New Haven, Connecticut, concerns the association of a rare neoplasm and leucemia with a paucity of evidence of chronic lymphatic leucemia at autopsy. Whether this represents a spontaneous remission or an unusually prolonged favorable response to roentgen ray therapy is not clear. One may subscribe to the point of view that leucemias are neoplastic in origin and that the occurrence of a second primary neoplasm frequently inhibits the growth of the first one.

The literature on pleural endothelioma indicates that cases have been overlooked because symptoms suggest chronic inflammatory disease. Metastasis occurs late after the initial growth has become widely distributed over the contiguous pleural surfaces and there is no characteristic clinical or roentgenographic picture. Involvement of the pleural sac on the right side in males between the ages of 40 and 50 years is most common.

Physical examination of a patient with a fully developed clinical picture reveals dyspnea, orthopnea,

and sometimes cyanosis. The temperature is usually normal with an elevated pulse and respiratory rate. The chest findings are those of pleural effusion with shifting of the mediastinum to the contralateral side. Films taken after thoracentesis with air replacement of the fluid may reveal multiple tumor nodules on the surface of the pleura. Marked force is necessary to insert the needle into the pleural cavity. Fluid is frankly bloody or tends to become so on repeated taps and rapidly reaccumulates. An important differential point from tuberculous pleurisy is that dyspnea is not relieved by thoracentesis. Malignant cells are often reported on microscopic examination, but mesothelial cells can grow and multiply in such fluid.

The clinical course is that of advanced malignancy. Life expectancy is given as from 6 months to 2 years. Treatment is essentially palliative and the disease is invariably fatal.

At autopsy the lung is encased and compressed. The pleura is thickest at the base with a gristlelike sensation on transection. The inner surface of the pleura is finely nodular. The lung parenchyma is not involved. Metastasis involves the pericardium, the contralateral pleura, the diaphragm, and, in the peritoneal cavity, the mesentery near its intestinal attachment, the appendix, liver, spleen, kidneys, adrenal glands, and infrequently the ovaries and inguinal nodes. Axillary and cervical node involvement may occur. Ewing refers the origin of the tumor to cells of the subpleural lymph spaces or to the lining cells of the pleura.

The case reported is typical of pleural endothelioma clinically and pathologically. The patient's original complaint, however, was chronic exfoliative dermatitis with marked lymphocytosis showing dermophoblasts. Against the diagnosis of a primary skin disease with a leucemoid reaction is the fact that during the next few years the patient developed generalized adenopathy, splenomegaly, and the blood picture of chronic lymphatic leucemia, which was repeatedly confirmed. A leucemoid reaction to pleural endothelioma is unlikely since bone metastasis was not verified at autopsy and the blood picture preceded, by years, the onset of symptoms of a rapidly fatal intrathoracic malignancy. Also, the spleen showed a picture compatible with lymphatic leucemia during a remission and was without metastatic lesions.

LYNN JOHNSON, M.D.

## HEART AND PERICARDIUM

Begg: Calcification of the Left Auricle. *N. Zealand M. J.*, 1945, 44: 315.

A case of calcification of the left auricle is described. It is the second case in which a roentgenographic record of the condition was made during life.

It appears that the primary lesion was a stenosis of the mitral valve, which led to chronic enlargement of the left auricle and subsequently to auricular fibrillation. Satisfactory compensation of the right heart enabled the patient to lead an active life with-

out any symptoms of cardiac origin. During this time, calcium was deposited in the walls of the dilated left auricle and in the mitral valve, as a degenerative change. As this occurred, mitral incompetence increased with consequent enlargement of the left ventricle. These gross changes had little effect on the patient until the right ventricle began to fail.

This type of endocardial calcification has not been reported as occurring in the right auricle or in either ventricle.

SAMUEL KAHN, M.D.

### ESOPHAGUS AND MEDIASTINUM

Rafsky, H. A., and Herzig, W.: Scleroderma with Esophageal Symptoms. *Gastroenterology*, 1946, 6: 35.

Ehrmann, in 1903, described esophageal disturbances in scleroderma, and several other authors have described cardiospasm, dysphagia, and esophageal changes in this condition. Changes in the small intestines have also been recorded. Five cases of this disease have been "esophagoscoped," and in 2, biopsies have been obtained.

The authors report 2 additional cases of scleroderma, in one of which a biopsy was taken esophagoscopically. This revealed only normal squamous epithelial cells, however. The microscopic changes described in the other biopsied case revealed "a fibrous membrane with or without mucosal destruction; the membrane was thick, containing fibrin, polymorphonuclear leucocytes, eosinophils and newly formed capillaries with large endothelial cells. The muscularis mucosa was invaded with polymorphonuclear leucocytes, eosinophils, and other inflammatory cells. The connective tissue was dense with some cells of a fibrocytic nature."

Scleroderma is recognized as the skin manifestation of a disease which affects several systems, including the skeletal, vascular, and gastrointestinal. One of the cases reported gave signs of circulatory impairment in the hands and feet; dysphagia appeared later on, and finally arthritic and skin changes were noted. The second case gave signs of circulatory impairment, then of dysphagia followed by arthritic manifestations, and finally there were skin changes. The early diagnosis of scleroderma may be difficult, until skin as well as other changes are present. One of the authors' diagnoses was confirmed by skin biopsy.

The case reports are given in some detail and illustrative roentgenograms are reproduced.

HIRAM T. LANGSTON, M. D.

Diaz, F., and Riera, M.: Esophageal Peptic Ulcer (La ulcera peptica del esofago). *Rev. méd. Chile*, 1945, 73: 1053.

Esophageal peptic ulcer was recognized by Albers in 1833. Its frequency as compared with gastric ulcer is about 1 to 30.

Generally, this ulcer occurs in the lower third of the esophagus. When it occurs higher it is usually due to causes other than peptic, such as pressure

around an inlying tube. The peptic ulcer is penetrating in type with well defined borders; an older one may be indurated and irregular. It heals by cicatrix. Esophageal spasm is frequently associated with this ulcer.

From the etiologic standpoint the following must be considered: (1) action of the gastric juice, be this by regurgitation, particularly if hyperchlorhydria exists, or by secretion from ectopic gastric mucosa; (2) any condition favoring dysfunction of the cardia and permitting regurgitation, such as pyloric stenosis, herniation of the stomach through the diaphragm, a short esophagus, or lower esophageal spasm; (3) some ill defined local lack of resistance to digestive action, perhaps related to a tendency to form thromboses or varices; (4) a "diathesis" in view of the association of esophageal with gastric and duodenal ulcers, and (5) esophagitis, although its relation to the condition is not clear.

Symptoms, when present, include: pain (in 84%) associated with swallowing, of variable intensity, retroxyphoid in location, and radiating sternally, to the neck, or to the shoulder region; dysphagia, which is frequent; and vomiting, especially regurgitation.

Complications include hemorrhage, perforation, and cicatricial stenosis or periesophageal adhesions.

The diagnosis is made by roentgenologic or endoscopic examination. One or both of these means in the order given may be required. The signs of this condition include: (1) spasm, (2) demonstrable defects, (3) a delayed passage of barium which is retained in the involved segment, (4) insufficiency of the sphincter of the cardia, (5) stenosis with proximal dilatation, and (6) dilatation of the lower third of the esophagus. The various subtypes of signs 1 and 2 are elaborated, and a discussion of the basic requirements for diagnosis regarding chronicity, the presence of free acid, and ectopic gastric mucosa is presented.

Seven case reports are given and their symptoms, and roentgenologic and endoscopic findings are analyzed. One case of associated esophageal cancer is included.

Thirty-three references to the literature are appended.

HIRAM T. LANGSTON, M.D.

### MISCELLANEOUS

Betts, R. H., and Lees, W. M.: Military Thoracic Surgery in the Forward Area. *J. Thorac. Surg.*, 1946, 15: 44.

This report relates the experience of a thoracic surgical team of an auxiliary surgical group in Italy attached to the field or evacuation hospitals from December, 1943 to June, 1944. Circumstances required that this team care for casualties other than thoracic, although these were handled by preference. There were 192 patients treated, 164 of whom had thoracic injuries. There were 7 deaths, a mortality of 3.6 per cent. Many of the patients had associated injuries which were often more menacing than the thoracic injury.

In the preoperative preparation of the patients, disturbance of the cardiorespiratory physiology in addition to shock from the usual causes is very important. An airtight functional thoracic cage was generally managed in the Aid Stations. The clinical picture of shock may be produced by anoxia alone. Even relatively small amounts of air or blood in the pleura may, by their presence, aggravate a precarious general condition due to other factors. Aspiration of the pleura is, therefore, indicated. Excessive pulmonary secretions may reduce effective ventilation and should be relieved by coughing or intratracheal suction. Pain is best relieved by intercostal block.

Replacement of the blood which has been lost is necessary. One must be careful not to overload an already taxed circulatory system, particularly in blast injuries or excessively "wet lungs." Such cases may respond to serum albumin administration in such fashion that replacement therapy may be carried out. Oxygen is indicated for anoxia. The thoracic patient should be allowed to stabilize preoperatively, in contrast to the patient with wounds of the abdomen or extremities, in whom the avoidance of infection by immediate surgery is indicated. A thorough x-ray study is invaluable.

A competent anesthetist is indispensable. Intratracheal anesthesia is used for all penetrating and perforating wounds. Morphine was not given, since large doses had usually been administered previously; however, atropine was given. Local anesthesia was used for injuries of the chest wall only.

Surgical treatment was given to 82 lesions of the chest wall. The most troublesome involved the shoulder girdle and scapular region. Preservation of the upper third of the scapula is advantageous from the ultimate functional standpoint. Débridement should, however, be adequate. One fatal case of clostridium oedematis infection occurred.

Penetrating or perforating wounds are often referred to as "sucking wounds." This term is unfortunate and meaningless, since this characteristic depends upon the relation of the pleural opening to its extracostal coverings.

Since blood is uniformly present, aspiration is indicated. From 1,200 to 1,500 c.c. are sufficient for removal at one sitting. Air replacement is condemned. The lung is not a source of severe bleeding. In the absence of diaphragmatic perforation, intrapleural blood may be autotransfused. Attempts should be made to render the pleura dry.

Penetrating and perforating wounds may be divided into small (pleural defect less than 6 cm.) and large (pleural defect greater than 6 cm.) wounds.

Small wounds should be débrided or excised. When feasible, a catheter is inserted into the pleura and this is emptied. Irrigation with from 1,000 to 2,000 c.c. of saline solution is practiced. The wound is closed, except the skin, the pleura being aspirated through the catheter as the lung is inflated. The catheter is withdrawn as the last suture is tied. Attention is called to the careful removal of any

indriven rib fragments, particularly if they project from the chest wall. There were 49 cases in this group with no deaths.

Large wounds are considered traumatic thoracotomies. There were 14 cases with 2 deaths. This situation is considered an indication for thoracotomy. There were also cases of thoracoabdominal wounds, uncontrolled hemorrhage, large lung lacerations, and certain retained foreign bodies. Since many of these defects require tight closure, débridement should be as radical as is compatible with a stable chest wall. Closure of the chest wall often taxes the surgeon's ingenuity. Postoperative dressings should support the closure.

There were 19 cases of thoracoabdominal wounds. Seventeen were operated upon with 3 deaths, a mortality of 17.6 per cent (1 patient died preoperatively and 1 was transferred before operation). The surgical approach in these cases can be varied, but the upper abdomen can be adequately managed transdiaphragmatically, whereas the thoracic injury cannot be managed from below. A separate abdominal approach may be required for some lesions. The colon was exteriorized three times from above without infection. The diaphragm was repaired in two layers. Liver wounds should be packed and drained by subcostal stab wounds.

Severe bleeding most often comes from one of the systemic vessels, and a partially severed intercostal vessel was the only one seen at operation. No cardiac wounds as a cause for severe bleeding were treated. Intrathoracic metallic foreign bodies are removed if accessible easily. No major resection of the lung tissue was believed to be indicated in the lacerations seen. The thoracotomies were closed without drainage, but assiduous aspiration of fluid or air was practiced postoperatively.

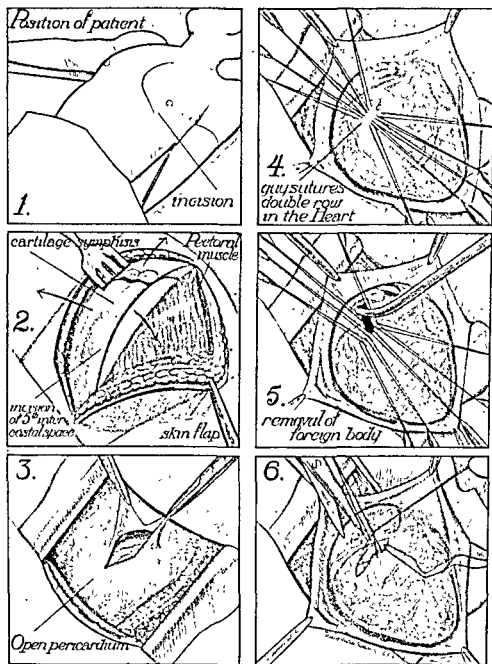
The postoperative period is concerned with expansion of the lung and maintenance of a clear tracheobronchial tree. Attention is called to a possible noxious vasovagal reflex occurring during bronchoscopy, particularly at the end of general anesthesia. Atropine is considered a preventative. The urinary output is kept around 1,000 c.c. daily. Blood and plasma are given as indicated by laboratory studies. Pain is best relieved by paravertebral block. Oxygen is used freely.

Four illustrative case reports are appended, and provisions for the distribution of casualties so that they are accessible to skilled thoracic care are discussed.

HIRAM T. LANGSTON, M.D.

Harken, D. E.: A Review of the Activities of the Thoracic Center for the III and IV Hospital Groups, 160th General Hospital European Theater of Operations from June 10, 1944, to January 1, 1945. *J. Thorac. Surg.*, 1946, 15, 31.

A chest center was established shortly before D Day in Normandy and a training period was begun for the assigned personnel. Four days after D Day the real work of the center began and 937 cases were treated. Five per cent of the casualties



Felix Weinberg

Fig. 1. Diagrammatic representations of the principles involved in the hemostatic removal of intracardiac foreign bodies, without interruption of the blood flow.

coming to the United Kingdom base section suffered major thoracic injuries. In the accompanying tables, the mortality shown for empyema was due to the associated injuries.

The principles in the treatment of various pathological conditions are discussed.

**Hemothorax.** The treatment in essence was complete aspiration and breathing exercises. The complications were (1) empyema, (2) reduced pulmonary function, (3) late pulmonary suppuration, and (4) deformity. Clotting occurred in approximately 10 per cent of the hemothoraces. Decortication was resorted to after about 2 weeks (in inspirable uninfected cases) if improvement from x-ray treatment

and breathing exercises was not adequate. Sixty-four cases were subjected to decortication. There were 48 contaminated multiloculated hemothoraces. Decortication without residual empyema was achieved in more than 75 per cent of them. When present, empyema was easily managed by open rib resection drainage. This complication was usually associated with a bronchopleural fistula. In a small number of cases decortication was performed for signs of acute cardiorespiratory embarrassment when relief by drainage or aspiration was impossible because of clotting.

In the infected cases, rib resection drainage was adequate for empyemas of 500 c.c. or less.

TABLE I. DISTRIBUTION OF PATIENTS WITH CHEST INJURIES ADMITTED TO GENERAL HOSPITALS IN THE UNITED KINGDOM BASE

Conditions	SECTION		
	Percent- age	Percent- age	Percent- age
Hemothorax .....			70
Unclothed .....		60	
Infected .....	3		
Uninfected .....	57		
Clotted .....		10	
Infected .....	4		
Uninfected .....	6		
Retained foreign bodies .....			15
Requiring surgical removal .....		8	
Thoracoabdominal wounds .....			8
Hematoma of the lung .....			4
Injuries of the heart and pericardium .....			
Including retained foreign bodies .....			3

Twenty per cent of this group were referred to thoracic surgical centers.

**Empyema.** Ninety-one resections were done for infected hemothorax or empyema. Policies in treatment involve: (1) early adequate drainage, (2) general and specific remedial exercises (including ambulatory treatment), (3) the maintenance of a state of acute inflammatory reaction in the cavity to prevent hyalinization and promote obliterative pleuritis (irritating packs are advocated for this), and (4) the maintenance of nutrition.

**Thoracoabdominal wounds.** There were 35 cases treated surgically. The empyemas were drained by rib resection, and associated subphrenic or liver abscesses were drained into the empyema transdiaphragmatically.

**Removal of foreign body.** The foreign bodies in the lung are removed if they are more than 1.5 cm. in two dimensions. Foreign bodies are generally removed to prevent hemorrhage and suppuration. Their removal is influenced by: (1) their size and irregularity, (2) their proximity to major vessels or the bronchi, and a dependent position in the parenchyma, and (3) the surrounding reaction. One hundred and sixty-two missiles were removed with no mortality. Eighty-five per cent of the missiles harbored culturable pathogenic bacteria, but only 2 empyemas resulted from 200 thoracotomies for removal of intrathoracic foreign bodies.

Cardiac foreign bodies are removed to (1) prevent embolism (by the foreign body or an associated thrombus), (2) reduce the danger of bacterial endocarditis, (3) prevent recurrent pericardial effusions, and (4) diminish the incidence of myocardial rupture or hernia. Thirty-two foreign bodies that were in or on the heart were removed, 9 were in the chambers. No deaths occurred. A composite diagram of foreign body location in these cases is given.

The steps in and modus operandi of the specified remedial exercises referred to originally are elaborated upon as a new therapeutic procedure adopted from the British. They lead to a return of function

TABLE II. DISTRIBUTION OF THE PRINCIPAL TYPES OF SURGICAL PROCEDURES, WITH 'MORTALITY RATES

Surgical Procedure	Number of Cases	Deaths	Mortality Rate (Per Cent)
Removal of foreign bodies .....	247 <sup>1</sup>	1	0.4
Lung .....	162	0	0
Mediastinum .....	21	1	4.5
In or in relation to the heart .....	37	0	0
(chambers of heart) .....	9	0	0
In or in relation to great vessels .....	7	0	0
Diaphragm .....	10	0	0
Subphrenic area .....	14	0	0
Pleural space .....	37	0	0
Decortications .....	112	1	0.9
Uninfected clotted .....	64		
Infected clotted .....	48		
Thoracoabdominal operations .....	35	0	0
Liver abscess .....	11	0	0
Subphrenic abscess .....	10	0	0
Hepatobronchial fistula .....	8	0	0
Diaphragmatic hernia .....	6	0	0
Lobectomy (including partial) .....	15	0	0
Repair of injuries to major vessels .....	5	0	0
Rib resection drainage of empyema .....	91	5	5.5

<sup>1</sup>Discrepancy due to subgroup overlap.

to the long splinted, and therefore contracted, and variously immobilized thoracic cage or parts thereof. This effect is secured by the patient's acquiring the ability to voluntarily control motion in these various areas, which include the rib cage as well as the diaphragm.

HIRSH T. LANSBURY, M.D.

Overholt, R. H., and Wilson, N. J.: Silent and Masquerading Intrathoracic Lesions. *N. Engl. J. Med.*, 1946, 234: 169.

Mass surveys reveal three outstanding types of intrathoracic lesions: tuberculosis, carcinoma of the lung, and mediastinal tumors. The full value of survey work will not be realized unless a proper disposition of all the lesions is made in advance of the time when most of the patients ask for help because of symptoms. The potentialities of this type of preventive medicine are great.

Small tuberculous lesions with exudative or caseous foci carry an immediate threat; but if they are fibrotic or calcified, inactivity must be demonstrated to guard the patients against long periods of unnecessary therapy, and to protect those with active lesions by prompt energetic treatment.

Any lesion shedding tubercle bacilli has some activity. Ninety-nine per cent of the patients with active tuberculosis are found to harbor tubercle bacilli by means of the concentration technique of pooled specimens and the study of gastric washing by multiple culture and guinea pig inoculation. The fundamentals of successful treatment of tuberculous foci are early discovery of the lesion, and prompt, energetic, and prolonged treatment with bed rest, preferably in a sanatorium, and the judicious supplementary use of collapse measures.

Evidence points to the absolute and relative increase in incidence of bronchogenic carcinoma of the

lung occurring chiefly in males over 40 years of age. X-ray manifestations depend on (1) the type and location of the tumor, (2) the degree of bronchial occlusion, (3) whether infection in the parenchyma has taken place, and (4) whether mediastinal or chest wall extension has taken place. X-ray findings may be indistinguishable from tuberculosis, bronchiectasis, unresolved pneumonia, or suppurative disease. If the lesion is caused by carcinoma, speed in diagnosis and surgical extirpation offer the only chance for cure.

Diagnostic procedures include: (1) search for peripheral metastasis for biopsy, (2) bronchoscopy, about 50 per cent efficient in securing tissue for examination, (3) lipiodol bronchography, (4) study of the sputum for malignant tissue, usually disappointing, (5) aspiration biopsy, and (6) exploratory thoracotomy, which is as safe and accurate as abdominal exploration to determine the diagnosis and operability. Following the examination of a frozen section, surgery can be carried out immediately.

Mass surveys show that mediastinal tumors are much more frequent than has been suspected from

previous clinical and autopsy data. Localization is important in determining the type. Most frequent in the posterior mediastinum are ganglioneuromas and neurofibromas, while in the anterior mediastinum dermoid cysts, teratomas, malignant lymphomas—lymphosarcoma Hodgkin's disease, and leucemic lymphoma—are most frequent.

Surgical extirpation is indicated in benign tumors, with rare exceptions. Benign tumors grow slowly and are usually oval or circular, quite dense, and sharply delimited. Malignant tumors grow rapidly, and tend to be lobulated and less sharply defined. Cervical or axillary nodes are frequently associated with malignant lymphomas and should be biopsied. Dermoids and teratomas may reveal teeth or bones in heavy exposure roentgenograms with a Potter-Bucky diaphragm. Fluoroscopy and roentgen kymography assist in ruling out aneurysm. In anterior mediastinal tumors a therapeutic test dose of x-rays is advised. If the tumor fails to respond within from 4 to 6 weeks, surgical exploration is indicated without delay to avoid technical difficulties resulting from the effects of the x-rays on local tissue.

LYNN JOHNSEN, M. D.



# SURGERY OF THE ABDOMEN

## ABDOMINAL WALL AND PERITONEUM

Turnbull, H.: *Inguinal Hernia and Its Repair*. Med. J. Australia, 1946, 1: 109.

The Bassini operation is standing its trial. English surgery in particular has been vehement in its condemnation, and unequivocally demands the death of the Bassini technique.

Turnbull makes a plea for the retention in surgery of the Bassini operation. He presents the criticisms of the operation and endeavors to answer them in order.

1. Statistics of recurrences must always be suspect, and cases are presented to illustrate how treacherous and misleading figures without detail can be.

2. Ogilvie's arguments that (1) suturing the conjoined tendon to the inguinal ligament means a muscle working out of place, (2) the abdominal wall is weakened, and (3) recurrence is favored rather than prevented, are answered in discussing the anatomy of the inguinal region.

In giving the causes of recurrences, it is stated that all indirect hernias are congenital, and Nature has fallen down on her job; that it is thus beyond our means to prevent the occurrence of hernia, but by adequate operation planned on physiological and anatomic grounds, the condition can usually be cured and recurrences largely prevented. The causes of recurrence in most cases can be labelled as bad surgery due to ignorance of the condition, and are discussed under headings of poor technique, ill advised operation, faulty preoperative supervision, faulty suture material, and postoperative complications.

The author believes that there are only two hernia operations that should ever be performed: (1) simple excision of the sac with tightening of the transversalis fascia; (2) a modified Bassini repair, alone, or combined with a fascial graft. In his opinion, all other operations are superfluous. His technique of the modified Bassini repair is presented in detail.

After disposing of the sac by high suturing and amputation, the incised fascia is united with a few interrupted silk sutures cut directly on the knot, and the under surface of the conjoined tendon is completely freed from the transversalis fascia until it can be grasped as a separate entity. The transversalis fascia is tightened and strengthened. This is done either by a purse-string suture or by interrupted silk sutures. The internal ring is now narrowed by interrupted sutures placed on the inferomedial surface until the ring is comfortably tight and admits only the tip of the finger. The neighboring lateral border of the rectus sheath, the area of the linea semilunaris, is sutured to the periosteum of the pubic tubercle. The needle must be felt to bite in and the suture grip hard. This is the most important stitch in the whole

repair. It fixes the most medial point of the conjoined tendon and relaxes the rest of the tendon, enabling it to be sutured to the inguinal ligament without tension.

Vertical mattress sutures of silk are then used for the repair. The fibers of the inguinal ligament run longitudinally, so that the sutures must not be inserted parallel to the fibers, but across them; otherwise they will tear out, split, mutilate and weaken the ligament, and thus weaken the repair. The second important point in the application of these sutures is that they must be tied on the distal surface of the inguinal ligament—that is, on the femoral triangle side. The conjoined tendon is stitched to the inguinal ligament by interrupted sutures until it fits snugly under the cord emerging from the internal ring. One or two sutures are now inserted above the cord, uniting the internal oblique to the inguinal ligament. This is an important step in strengthening the internal ring, for the repair is now firm all around the emerging cord.

The external oblique is repaired with interrupted "figure of eight" sutures. The external oblique may be redundant. If so, it is overlapped after the method of Mayo. If it is considered necessary to further strengthen the repair, fascial strips from the external oblique should be plaited into the repair.

Except for the method of dealing with the sac, the operation of repair for direct hernia is the same as the modified Bassini operation described.

STEPHEN A. ZIEGLER, M.D.

Fisher, H. C.: *Postappendectomy Interstitial Inguinal Hernia*. Ann Surg., 1946, 123: 419.

An unusual type of hernia was encountered in 8 of 369 cases of right inguinal herniorrhaphies. The patients had had an appendectomy from 4 to 27 years previously. They presented the typical findings of a right inguinal hernia with a reducible, bulging mass at the external inguinal ring which descended with increased intraperitoneal pressure. The findings at operation were in contrast to those of the usual inguinal hernia, however. No sac of the peritoneum could be found in the inguinal canal. Instead, an omental mass was present which coursed beneath the transversus abdominis and internal oblique muscles to pass through a peritoneal defect at the original McBurney incision. To explore this region adequately it was necessary to open the peritoneal cavity. In only 1 case of the 8 was an associated inguinal hernia (indirect) discovered. This type of hernia was described in 1911 by Hogue.

In this series a modified Bassini procedure was used and the patients were allowed to be active after 14 days of bed rest. No recurrences were observed in a period of from 3 months to 3 years.

This hernia occurs in the presence of poorly closed or drained, or infected appendical wounds. The

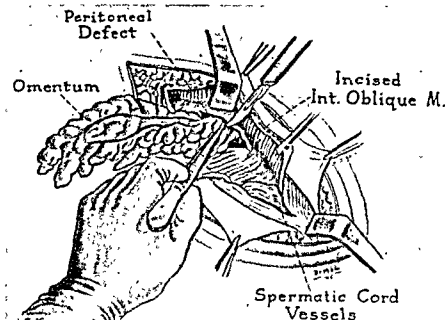


Fig. 1. Diagram illustrating the dissection of the omentum from the parietal peritoneum in the region of the defect. (Courtesy of J. B. Lippincott Co.)

necessity for careful exploration of the inguinal region by opening the peritoneal cavity is stressed.

C. FREDERICK KITTLE, M.D.

during the noon instead of the evening meal. Conservatism is advised when surgery is considered or is undertaken for duodenal ulcer in man.

WALTER H. NADLER, M.D.

### GASTROINTESTINAL TRACT

Sandweiss, O. J., Sugarman, M. H., Podolsky, H. M., and Friedman, M. H. F.: Nocturnal Gastric Secretion. *J. Am. M. Ass.*, 1946, 130: 258.

On the basis of 150 nocturnal gastric secretion studies performed on 38 normal persons (73 studies) and on 29 patients with duodenal ulcer (77 studies), the authors report the following impressions:

Both normal individuals and patients with duodenal ulcer secrete acid gastric juice during the night even when the evening meal consists of foods usually allowed ulcer patients. After a fairly well balanced meal at 6:00 P.M., the hydrochloric acid concentration is approximately the same in both groups, and following this meal the nocturnal volume of gastric juice obtained by continuous suction is on the average not greater in ulcer patients than in normal persons. However, when intermittent single aspirations are performed during the night a greater quantity of gastric juice is found in ulcer patients than in normal subjects of the same sex, probably because of a state of delayed gastric emptying. Only 1 of the ulcer patients studied seemed to have a tendency toward gastric hypersecretion.

The authors point out that if hydrochloric acid is the chief factor in ulcer distress and delayed healing, more attention must be paid to the nocturnal phase of gastric secretion even though no symptoms are present. Feedings during the night are, therefore, essential. When meat and fish are added to the diet of ulcer patients it is advisable to include them

Valle, A. R., and White, M. L., Jr.: Thoracic Gastric Cyst. *Ann Surg.*, 1946, 123: 377.

There is a great variety of cysts which occur in the mediastinum. One of the more unusual types is of entodermal origin—the gastric cyst. There are two kinds of gastric cysts, those that are acid secreting or functionally active, and those of which the mucosa is without functional activity. Even though the acidity of the cystic secretions was not determined in the reported case, the early manifestation of symptoms (primarily hemorrhage) is so typical of the proved functionally active cases in the literature that the authors believed they were justified in classifying this case as an acid secreting or functionally active cyst. From a review of the literature it is found that there are two constant characteristics of a gastric cyst—it always occurs in the posterior mediastinum and always on the right side. The functionally active cysts usually manifest themselves by symptoms at an early age, whereas the inactive ones may be discovered accidentally in a routine chest roentgenogram later in life.

There are several theories about the origin of endothoracic gastric cysts. They have been ascribed to a pinching off of an evagination of the embryonic foregut, to an intrathoracic vestige of the omphalo-mesenteric duct, and to a proliferation of entodermal germ cells of the esophagus capable of producing gastric epithelium.

The cyst wall has all the elements of the stomach wall. Smith and Stachelin-Burckhardt have each reported a case which exhibited both gastric mucosa

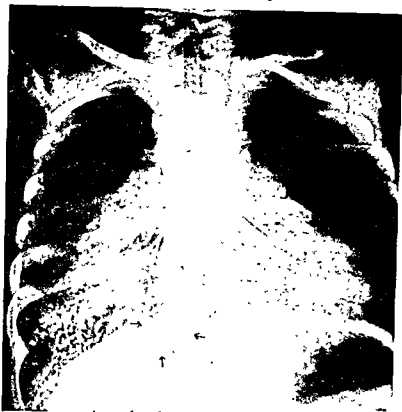


Fig. 1. Bronchogram showing cyst communicating with the right lower lobe bronchus. Arrows outline the cyst which is partially filled with iodized oil.

and ciliated stratified respiratory epithelium in the same cyst. Boss has described a case in which the intrinsic nerves and ganglia of the gastric musculature were identified.

In the case reported by the authors, the cyst perforated the diaphragm and terminated in a blind sac about 5 cm. below it. This feature has not been reported in the literature. The cyst did not communicate with the stomach or the esophagus. Erosion of bone may be caused by the cyst as was reported by Mixer and Clifford as occurring in one of their cases.

The most commonly observed symptoms of gastric cyst are dyspnea, cyanosis, cough, dysphagia, and, sometimes, even in infants, hemoptysis. The most striking symptom in the authors' case was the massive hemoptysis which necessitated admission to the local hospital on 9 different occasions, with multiple blood transfusions during each period. Both Boss and Seydl reported hemoptysis in their cases and attributed it to the presence of chronic peptic ulcers in the gastric cyst. In both cases the ulcers penetrated into the adjacent lung and caused fatal pulmonary hemorrhage. Although no peptic ulcer could be demonstrated in the specimen from the authors' case, it is probable that one had been present, since the cyst had eroded into the right lower lobe bronchus and was draining through the bron-

chial tree. Inasmuch as this cyst was functionally active, the hemoptysis was probably due to bleeding from the ulcer itself and to the action of the gastric juice on the parenchyma of the lung and the bronchial tree.

The physical findings are variable but are usually those of pulmonary atelectasis or pneumonia. There may be some cardiac displacement, scoliosis, or, rarely, bulging of the chest. The findings in this case were primarily those of severe pneumonia. The generalized bronchiectasis of the right lung, a complication resulting from the rupture of the cyst into the bronchial tree, has not been previously reported.

It is difficult to diagnose a gastric cyst during life with any degree of certainty without exploratory operation. However, the diagnosis is possible if gastric juice is aspirated directly from the cyst. The cyst may contain from a few cubic centimeters to 400 c.c. of fluid. The reaction is usually acid but may be neutral. Roentgenograms in both the postero-anterior and lateral projections are important, but the lateral view is particularly so, as it shows the cyst in the posterior mediastinum. Iodized oil cyst in the posterior mediastinum. Iodized oil bronchography is of use to show whether or not the cyst communicates with the bronchial tree and, if it does, to demonstrate its size, shape, and location. In this case a diagnosis of posterior mediastinal cyst



Fig. 2. Photomicrograph showing typical gastric mucosa and bronchial cartilage (Courtesy of J. B. Lippincott Co.)

communicating with the bronchus, complicated by generalized bronchiectasis of the right lung, was made preoperatively. However, it was not until the typical gastric mucosa was seen when the cyst was opened during operation that the correct diagnosis was suspected.

The only treatment for gastric cysts is complete removal. If only a minute amount of the mucosa remains in the chest it will secrete and cause further complications such as empyema or a draining sinus, with or without excoriation of the skin. To date surgical treatment has not been too successful. Of the 17 cases summarized, 10 were given surgical treatment. Five of the patients survived, which represents an operative mortality of 50 per cent. Two of these had a successful two-stage operation (drainage and later excision), and 3 had a one-stage removal.

The high mortality is quite probably due to several factors: the patients are usually infants; they are usually in poor condition for a major operation; it is difficult to administer anesthesia; and the dissection of the cyst from the mediastinum is technically impossible in some cases. The last factor is due probably to adjacent inflammatory reaction from the functional activity of the cyst. In some cases in which complete removal of the cyst is impossible in a one-stage operation, preliminary drainage is useful as a palliative measure.

CHARLES BARON, M.D.

Koster, K. H., and Trolle, D.: Investigations of Postoperative Shock: Hemoconcentration, Plasma Protein, and Blood Electrolytes after Gastrectomy. *Acta chir. scand.*, 1946, 93: 51.

The authors believe that it is profitable to study the lessons of shock in civilian surgery. It can be studied in closer detail than under war conditions.

The circulation is severely taxed after any major abdominal operation, as the blood volume is reduced. Often this strain is easily overcome, but if it exceeds the body's compensatory powers, the insufficient circulation will dominate the clinical picture. Postoperative alterations in circulation are due to the reduction in blood volume from the loss of blood, loss of plasma into the tissues, and a high degree of dehydration. Blood pressure falls are due to sympathetic stimulation from manipulation of the viscera, and anesthetization of the splanchnic area. The reduced blood volume leads to falling venous pressure, diminished diastolic filling, and reduced cardiac output, with increased rate and diminished stroke volume. To preserve blood for the carotids and coronary system, the peripheral vessels contract. The relative anoxemia of the capillaries which develops causes an increased plasma loss. This vicious cycle continues until the shock picture becomes manifest.

The fate of the patient depends on his ability to re-establish and maintain a normal blood volume with adequate cardiac output, circulation, and an adequate supply of oxygen to vital centers; and infusions of saline and blood are given to assist the body. It is not possible to recognize clinically an incipient reduction in blood volume—latent shock. As treatment should be instituted in this phase, variations in the blood volume during the postoperative period must be started.

Frequent blood volume determinations are impractical, so other methods of study are needed. Red cell counts and plasma protein determinations have been chosen as guides to variations in blood volume and water content of the body. Observation of the bicarbonate and chloride content of the blood will be helpful in studying the patient's total fluid balance.

The authors present an extensive study of 63 patients who underwent gastric surgery during the period from January, 1940 to July, 1943. Of these, 26 were operated upon for gastric ulcer and 37 for gastric carcinoma. Billroth II gastroenterostomies were done in all but 4 cases in which total gastrectomies (2) and Polya anastomoses (2) were done. Splanchnic anesthesia with novocaine, supplemented by local and nitrous oxide oxygen ether narcosis while closing the wound was used in every case.

Postoperatively, a duodenal tube was inserted in the efferent loop of the gastroenterostomy. Blood transfusions were widely used. Vasopressin to counteract paralytic ileus, vitamins, and sulfathiazole both interperitoneally and systemically, were given; 2,400 c.c. of fluid daily were taken through the tube, which was left in 8 days, if possible. When necessary,

supplementary infusions were given subcutaneously or intravenously.

Hemoconcentration is a guide to changes in the blood volume. Such changes in hemorrhage occur—and consist of dilution which is an indication of the body's attempt to maintain normal blood pressure. This occurs both in shock, when concentration shows a plasma loss from the circulating blood, and in dehydration, when the reduced blood volume indicates drainage of the extracellular water reservoirs.

In shock with hemorrhage, compensation occurs by vasoconstriction which reduces the capacity of the vascular bed, and by the inflow of tissue fluid. Restoration of blood volume begins soon after hemorrhage, and takes place rapidly. After a loss of from 15 to 20 per cent of the blood volume, the circulating volume is restored in a period of 3 hours. At this time the plasma volume is greater than before, and corresponds to a reduced cell volume. Provided sufficient fluid is available, a fall in the red cell count and plasma protein levels can be detected only a few hours after hemorrhage.

In shock without hemorrhage, there is a reduced blood volume and an increasing hemoconcentration due to plasma loss through more permeable capillaries. It is important to realize how great this plasma loss may be. A plasma volume reduction of 2,100 c.c. was found in a case of burns involving 12 per cent of the body surface.

Plasma constantly supplies fluid to secretions and insensible perspiration, and receives fluid from the intestines and available extracellular water (15 to 20 liters in an adult man). It is believed that this reservoir must be greatly reduced before a diminished plasma volume and an increased hemoconcentration occurs. It is obviously impossible to calculate the degree of fluid deficiency from the hemoconcentration.

In a long operation, with much bleeding and handling of viscera, two rival processes are initiated: (1) following bleeding, fluid moves from the tissues into the vessels, which decreases the hemoconcentration; (2) loss of plasma in the operative field and, eventually, in the peripheral areas, tends to increase the hemoconcentration. During the first few hours either process may predominate.

An account is given of pre- and postoperative investigations of hemoconcentration, plasma protein, plasma bicarbonate, and plasma chloride concentrations, and of the fluid balance of 61 patients who underwent gastrectomy.

A fall in hemoconcentration was observed in the patients who survived operation, the greatest fall occurring in those whose condition was best. In these patients, the dilution of blood was rapid and marked, which indicated an effective restoration of blood volume following the loss of blood during the operation.

In 12 patients, the hemoconcentration after operation was 25 per cent higher than before operation. All died, in spite of the fact that the hemoconcentration was successfully reduced to normal. An increase

of 25 per cent in hemoconcentration corresponds to a reduction of blood volume to 20 per cent. When the blood volume falls below this point, irreparable injury to the central nervous system occurs.

The authors were unable to demonstrate a rise in hemoconcentration as the result of blood transfusion.

The determination of plasma protein by measuring the specific weight of the plasma (without knowledge of the albumin-globulin ratio) is not reliable with respect to its colloid osmotic pressure. For this reason, and others, it is unreliable to depend on the edema limit—5.5 per cent protein in the plasma—when administering infusions of crystalloids.

Although 11 cases showed pulmonary edema at autopsy, all had had a plasma protein concentration of higher than 5.5 per cent.

No pronounced case of acidosis occurred in this series.

Plasma chloride concentration is discussed. It is emphasized that this factor cannot be an expression of the fluid demand of the organism and that one cannot administer fluid on the basis of these figures.

ROBERT R. BIGELOW, M.D.

Wangensteen, O. H.: The Ulcer Problem. *J. Lancet*, 1946, 66: 31

Two phases of the ulcer problem are discussed: (1) etiology, with special reference to the interrelationship between the vascular and acid-peptic digestive factor in the genesis of ulcer; (2) characterization of a satisfactory operation which will protect against recurrent ulcer.

The daily implantation of 30 mgm. of histamine base in beeswax and mineral oil was used as the method of ulcer production, and varied surgical procedures were then used to evaluate their capacity to prevent ulcer.

1. Four patients with fractures had either hematemesis or melena. A diagnosis of peptic ulcer was made, and it was concluded that fat emboli following fracture led to vascular obstruction and predisposed to peptic ulcer. This conclusion was substantiated by the appearance of ulcer in rabbits following the intravenous injection of fat plus the histamine base injection. Moreover, 3 rabbits injected with fat but given no histamine did not develop ulcer; and 2 rabbits given histamine alone also failed to develop ulcer.

An attempt was next made to produce chronic vasomotor arterial spasm by epinephrine injection. Previous studies had shown that it is difficult to produce ulcers in rabbits by the injection of histamine beeswax alone, but in the author's experiments on 4 rabbits, in which epinephrine was added to the histamine base, ulcer or erosion occurred in each instance. The possible role of pitressin in ulcer was also considered. Again, the conclusion was drawn that chronic arterial spasm invoked by epinephrine or pitressin produces local areas of anemia in the gastric mucosa. These areas then become susceptible to the acid-peptic digestive activity of the gastric juice.

If it appears safe to conclude that arterial spasm of gastric end vessels invites erosion of the gastric mucosa, why should not mucosal congestion secondary to venous stasis lead to the same result? In a study on rabbits and dogs, the venous flow from the stomach was partially obstructed. The results of the experiments showed that obstruction of the venous drainage from the stomach abets the ulcer diathesis. Erosion and ulcer were far more readily provoked when the histamine injection occurred in the presence of portal hypertension than when there was no obstruction of the venous outflow of the blood from the stomach. These conclusions were confirmed in a small series of patients having portal hypertension caused by cirrhosis of the liver or thrombophlebitis of the portal and/or splenic vein. Four out of 5 of these patients were cured of the gastrointestinal bleeding by an extensive gastric resection.

2. In the characterization of a satisfactory operation for ulcer, the problem was subjected to experimental scrutiny as follows: Three series of experiments were carried out on dogs. In each series a three-quarters gastric resection, including excision of the pylorus and antrum, was done. The only variable was the length of the proximal afferent duodenojejunal loop. The operation was the Hofmeister modification of the Billroth II resection. In series I, following extensive gastric resection, the gastrojejunostomy was performed as close to the inverted duodenal end as was technically possible. After a period of 3 months, the histamine beeswax was injected daily for from 40 to 45 days. None of these animals exhibited an ulcer.

In series II the same procedure was followed, with the exception that the afferent duodenojejunal loop was longer, now being 27 to 78 cm. as contrasted to the 15 cm. in the first series. A similar 3 months postoperative period was adopted; then the histamine base was injected daily. Gastrojejunal ulcer occurred in 100 per cent of this group of animals.

In series III the afferent duodenojejunal loop was 78 to 144 cm. The animals received no histamine. Fifty per cent of them died of spontaneous perforation of the gastrojejunal ulcer. The other 2 exhibited no pathology. From this study has evolved evidence indicating that a long afferent duodenojejunal loop invites stomal ulcer.

In the next experiment, an attempt was made to ascertain whether a less extensive gastric resection would protect against the histamine provoked ulcer if a Billroth I type of operation were done. In 3 series of dogs, the following results were obtained. After a 25 per cent gastric resection, 75 per cent of the animals developed stomal ulcer. When 50 per cent of the stomach was resected, again 75 per cent of the animals developed stomal ulcer, but when 75 per cent of the stomach was removed, stomal ulcer did not occur.

The success following a 74 per cent gastric resection with a short afferent duodenojejunal loop suggests that a satisfactory operation has been found.

SAMUEL J. FOGELSON, M.D.

Winkelstein, A.: The Prophylaxis of Peptic Ulcer. *Gastroenterology*, 1945, 5: 457.

The prevention of the peptic ulcer involves three separate problems: (1) the prevention of peptic ulcer in general, as a community problem; (2) the prevention of peptic ulcer in the individual; and (3) the prevention of peptic ulcer recurrences in the individual patient. These three problems naturally overlap.

The first of these factors requires the consideration and prevention of neurosis in adult life, often the result of psychic traumas in childhood. The dietetic habits of the American people should be improved; the excessive use of coffee, condiments, charged water, fried foods, and large amounts of fat, leads to gastric hypersecretion and spasm with primary and secondary inflammatory reactions. The injurious role of tobacco and alcohol in the problem of peptic ulcer should be given most serious consideration. There is also a high familial incidence of peptic ulcer. Julius Bauer, of Vienna, has shown that there are families in whom there is a strong tendency to acquire ulcer, "given the suitable exogenous aggressive factors." George Draper has reached similar conclusions from anatomic data.

In considering the prevention of peptic ulcers in an individual the above factors, as they apply to the ulcer type of patients, should be observed. The individual who has the "lean and hungry look of Cassius or the outspoken 'ulcus facies'" should be warned to avoid gastric irritants in so far as is possible. These individuals are characterized by an increase of interdigestive acid secretion which is present in ulcer patients and absent in the normal stomachs. When this gastric hypersecretion is absent during the night, the individual may be stamped as an ulcer candidate, and should be taught to avoid, or at least diminish, exposure to exogenous gastric irritants.

The prophylaxis of recurrences in the individual ulcer patient requires the serious consideration of (1) dietetic errors; (2) alcohol and tobacco; (3) emotional factors; (4) physical and mental fatigue; (5) seasonal or periodic recurrence, i.e., in the spring and in the fall; (6) infections (chiefly upper respiratory); (7) reflex causes (diseases elsewhere in the body, especially in the abdomen). The elimination of all such factors should be part of a prophylaxis effort.

Patients with ulcer should go on ulcer therapy during periods of physical and mental fatigue, in the spring and in the fall, during and after upper respiratory infections, after surgical procedures elsewhere in the body, and possibly regularly 1 day each week, and for 2 weeks every few months.

At the present time, the prevention of peptic ulcer as a military problem should be considered. In two large American Army hospitals, an average of 34 per cent of the patients with gastrointestinal ailments had ulcers. It was significant that approximately 80 per cent of the patients had ulcer symptoms previous to Army life. For this reason the conclusion

is drawn that men with a definite history of peptic ulcer should not be accepted for military duty.

SAMUEL J. FOGELSON, M.D.

Moses, William R.: Acute Obstruction of the Small Intestine. *N. England J. M.*, 1946, 234: 78.

One hundred and eighteen cases of acute, complete small bowel obstruction seen in a large municipal hospital are presented. Of the 118 patients treated, 10 died, a mortality rate of 8 per cent. The low mortality rate is attributed to the careful assessment of the general condition of the obstructed patient before any operative procedure is attempted rather than to emphasis upon the local disease. The method of treating acute obstruction of the small bowel is to provide surgical correction of the condition when the patient has reached the peak of general systemic improvement.

The number of patients seeking early municipal institutional care that would permit immediate surgery is small. However, in such a group of patients a prophylactic treatment is recommended for shock, intubation, suction, and blood or plasma before and during operation, despite their satisfactory condition on admittance. The larger group of patients demand an exhaustive study to assess the ability to withstand any contemplated operation. The author favors postponing surgery in this latter group until: the pulse is stabilized below 110; the blood pressure is at normal or near normal limits; the acid base balance is restored (as estimated by the type of respiration, the plasma carbon dioxide combining power, acetoneuria, determination of serum sodium and chloride levels, and so forth); hydration has been achieved (as determined by the feel and appearance of the tongue, blood urea nitrogen studies, the specific gravity and quantity of urine passed during preparation and hematocrit studies); the definite treatment of complications, such as pneumonia and heart failure, is well under way; there is significant improvement in distention, and the general effects of shock (sweating, pallor or cyanosis, coldness of the extremities, and mental torpor or severe anxiety) have been alleviated.

JOHN E. KARABIN, M.D.

Wood, W. Q.: The Treatment of Duodenal Ulcer. *Edinburgh M. J.*, 1945, 52: 433.

The problem of peptic ulcer has become increasingly important. It is not only a very common disease, but it has shown a steady increase in frequency as determined by the steady rise in mortality. In England and Wales, there were 43,000 deaths in the 10 years before the war, as a result of peptic ulcer. The number of men discharged from the Army up to December, 1941 (a little over two years) because of peptic ulcer was 23,574. Approximately 200,000 new cases in males each year are estimated to occur in England and Wales alone. Moreover, the frequency of perforation, observed in the hospitals of the West of Scotland, has more than doubled in the period between 1924 and 1941.

The etiology of duodenal ulcer is discussed, and emphasis is placed on the role of mental and psychophysiological strain. During the worst period of air bombardment in London, a marked rise was noted in the number of cases of perforated ulcer.

The methods of treatment have passed through several phases during the past 20 years. Specific decisions have been reached, which may be grouped into four points of view.

1. The treatment of the uncomplicated duodenal ulcer is a medical (not a surgical) problem.

2. Gastroenterostomy, in the absence of well marked organic stenosis, is a bad operation and is universally condemned.

3. In the presence of well marked stenosis, gastroenterostomy is a safe procedure and gives good results.

4. In patients with duodenal ulcer without stenosis, in whom operative treatment is indicated, an extensive partial gastrectomy (subtotal gastrectomy) is the only justifiable procedure.

Following the conclusion that subtotal gastrectomy is essentially a satisfactory procedure, alternative surgical procedures are considered, as follows: Gastroenterostomy again, but only under specific conditions; operations at the pylorus, such as pyloroplasty; gastroduodenostomy, which is condemned; partial gastric exclusion, as suggested by Devine, which is also found to be an unsatisfactory procedure; partial fundusctomy, as suggested by Connell, which has not been done sufficiently to warrant conclusions; vagotomy, which still requires further evaluation, and, finally, ligation of the gastric blood vessels which, in a limited series, was reasonably satisfactory. SAMUEL J. FOGELSON, M.D.

#### LIVER, GALL BLADDER, PANCREAS, AND SPLEEN

With, T. K.: The Bilirubin Production of the Human Organism and Its Significance in the Pathogenesis of Jaundice. *Acta med. scand.*, 1946, 123: 166.

That there is considerable individual variation in the production of bilirubin by the human organism has been shown by the author, who used several methods independent of each other.

Of 3 methods of determining bilirubin production, the most accurate is that of collecting the 24 hour output of bile and determining its bilirubin content. This was done on 35 cholecystectomized patients who had drains in their common ducts. About 7 days after operation the final constant level of bilirubin production was reached; it was found to be from 50 to 400 mgm. per 24 hours, and in most cases between 50 and 250 mgm.

The second method measures the bilirubin production in terms of the urobilinoid excretion with the feces. Since urobilinoids may be absorbed or destroyed in the intestine, this measure is only a rough correlation and, at best, represents only a lower limiting value for bilirubin production.

The third method is the determination of the excreted amount of urobilinoid plus bilirubin in the urine and feces in cases of jaundice. If there is not a complete biliary obstruction, this method is subject to the same error as the second method insofar as fecal urobilinoids are concerned. The error is eliminated if biliary obstruction is complete. However, variations in the bilirubin content of various depots in the body—the serum, the tissue fluids, the tissues themselves—prevent excretion from being an accurate index of production. In 5 patients who had subsequently proven complete biliary obstruction, the bilirubin excretion in the urine was 20 to 50 mgm. per 24 hours. This low figure may mean that production is actually lowered, or it may mean that the bilirubin is largely broken down before it can be excreted.

In cases of complete biliary obstruction, the severity of the jaundice (the serum bilirubin concentration) is influenced by bilirubin production and by the ability of the kidneys to excrete the bilirubin. As shown in the 5 cases mentioned, this renal excretory power is low; hence, the severity of the jaundice in complete biliary occlusion is largely a function of the bilirubin production.

One factor in the metabolism of hemoglobin which probably has not received proper consideration is that much of the heme of hemoglobin may give rise to bilifuscin and mesobilifuscin. Abnormally low bilirubin production resulting from this mechanism may explain some puzzling but unquestionably authentic cases of complete biliary obstruction and acute yellow atrophy of the liver in which there was no jaundice.

B. F. LOUNSBURY, M.D.

Shallow, T. A., Eger, S. A., and Wagner, F. B., Jr. Congenital Cystic Dilatation of the Common Bile Duct. *Ann. Surg.*, 1946, 123: 119.

There have been 182 cases of congenital cystic dilatation of the common bile duct reported in the literature, including the authors' case. The first case reported by the authors is a follow-up of a patient operated upon in 1941. The dilated common duct was removed and the right and left bile ducts were separately anastomosed to the duodenum. A follow-up almost 4 years later revealed the patient to be in excellent health. The bromsulphalein liver function test was normal and the Van den Bergh reaction was negative with a serum bilirubin of 1.0 mgm.

The second case was that of a 58 year old white woman. During the year prior to her admission she noticed her abdomen was gradually and persistently increasing in size. There was no discomfort or pain. Periodically her urine was darker than usual and her stools light in color. No jaundice was noticed. The abdomen was distended similar to an 8 month pregnancy but the tumor mass appeared to originate in the upper abdomen. The mass was mobile. The bromsulphalein liver function test showed 40 per cent dye retention. The Van den Bergh reaction was directly positive with a serum bilirubin of 2.0 mgm. The prothrombin time was within the normal.



Fig. 1. Roentgenological studies in Case 1, in which the cyst was excised. Arrow in (A) shows displaced stomach and duodenum preoperatively. (Courtesy of J. B. Lippincott Co.)

Roentgen examination of the gastrointestinal tract revealed the stomach and duodenum to be markedly pushed to the left. The hepatic flexure of the colon was displaced downward to the level of the brim of the pelvis. The cholecystogram was indefinite; no stones were seen.

At operation the common duct was hugely dilated and the gall bladder was normal. From the cystic mass 5,800 c.c. of thin, dark brown material was obtained, which was later shown to contain bile and a moderate amount of amylase. An anastomosis was made between the cyst and the duodenum.

Recovery was uneventful and 7 months later there was no abdominal swelling, jaundice, or pain. The stomach, duodenum, and colon were shown by x-rays, to be in normal position. There was 5 per cent dye retention following the bromsulphalein test and the Van den Bergh test was negative.

The authors state that the cyst should be removed only if it is small and the patient's condition is good. Anastomosis of the cyst to the duodenum is usually the preferable procedure.

EARL O. LATIMER, M.D.

Scott, H. W., Jr., and Bowman, J. R.: Traumatic Rupture of the Spleen. *J. Am. M. Ass.*, 1946, 130: 270.

Seven cases of traumatic rupture of the spleen were seen on the surgical service of the Children's Hospital, Boston, during the period from 1937 to 1944. All of the patients were boys and ranged in age from 4 to 13 years. Three patients were injured in falls, 3 in shelling accidents, and 1 patient was struck by a falling object. One patient had been



treated for erythroblastosis fetalis five years before the splenic injury. The spleen of this patient weighed only 64 gm. and was microscopically normal except for the changes due to the trauma. There was no case of delayed rupture of the spleen.

A child who has sustained an injury causing rupture of the spleen usually complains of abdominal pain; frequently this pain is in the left upper abdominal quadrant and occasionally it is referred to the left shoulder. The pain is shortly followed by evidence of acute blood loss. On examination there are pallor, anxious facies, varying degrees of shock, and tenderness and maximum muscular rigidity in the left upper abdominal quadrant. If there is progressive and extensive bleeding there are signs of abdominal fluid.

One child had paroxysmal pain resembling that of intussusception. The pain was referred to the left shoulder in 3 of the 7 children. All 7 children had symptoms of acute blood loss but only 1 was in severe shock. In 5 there was abdominal tenderness and left upper quadrant muscle spasm. In no case was the "Ballance sign" present—increasing and nonshifting dullness in the left flank. In 5 patients the red blood count on admission had fallen below 3,500,000 and in 2, approximately to 2,500,000. The leucocyte count varied from 10,600 to 18,000. X-ray examination did not contribute to the positive diagnosis in any case.

Immediate surgery is indicated. Adequate whole blood and plasma is given, the plasma being used until compatible blood is obtained. The technique of splenectomy differs only from elective splenectomy in that the pedicle is sought immediately and controlled.

Postoperatively, daily platelet counts should be made after the third or fourth day in anticipation of a "platelet crisis." Heparin is given if there is any evidence of thrombosis or if the platelet count is over 800,000, and continued as long as the count remains over 800,000. EARL O. LATIMER, M.D.

Doan, C. A., and Wright, C.: Primary Congenital and Secondary Acquired Splenic Panhematopenia. *Blood, J. Hemat.*, 1946, 1: 10.

The spleen is an organ of multiple structures and many functions which normally are in a state of physiological balance. The processes of blood cell formation, blood cell sequestration, and blood cell destruction normally represent a delicately balanced splenic equilibrium, which may be upset because of congenital accentuation or diminution of a function, or because of secondary involvement of the spleen in some general constitutional disease. A large variety of disturbances in the circulating blood equilibria due to splenic dysfunction may occur. The definitive proof of the primacy of the splenic influence in any given instance is the favorable result of total extirpation of all splenic tissue, medical management having proved completely ineffective. Instability in splenic functional balance with respect to any one of the essential elements of

the blood passing through the spleen may be an inherited trait, as in congenital hemolytic icterus. Primary splenic panhematopenia is a syndrome in which, despite compensatory panmyeloid hyperplasia, the indiscriminate elimination of all circulating elements occurs. Such a state of splenic dysfunction may simulate panmyeloid hypoplasia.

Three cases are reported illustrating splenic panhematopenia, in all of which splenectomy was followed by immediate and lasting improvement in the abnormal blood picture and in the general condition of the patients. The first case was one of congenital splenic panhematopenia occurring in a 14 year old girl who had a chronic relapsing form of the disease. That splenic panhematopenia may occur as an acute fulminant medical crisis was illustrated by a case occurring in a 24 year old woman, who showed dramatic improvement following emergency splenectomy. The third case was an example of splenic panhematopenia secondary to Gaucher's disease in a 20 year old female. The latter patient's sister, at the age of 6, had been subjected to splenectomy for Gaucher's disease.

The authors' studies fully confirm Nagel's interpretation of splenic pathological physiology, but they would not limit it to Gaucher's disease. The advantage of observing and analyzing fresh, surgically removed splenic tissue in the supravitral technique, which identifies both the phagocytic cells and their engulfed contents, strongly incriminates the splenic macrophages in all of the so-called hypersplenic syndromes. Platelets, as well as leucocytes and erythrocytes, can be readily recognized when they are present within the living splenic phagocytes, and the proportion of each thus discovered, sequestered and being destroyed in the spleen, is generally a good reciprocal index of the cellular units available in the circulation when the bone marrow is not depressed.

The differential diagnoses which must be considered by the clinician in the syndrome are threefold: (1) hypoplastic bone marrow, either primary, idiopathic, or secondary to some noxious agent; (2) splenic panhematopenia secondary to some constitutional disease which involves the spleen predominantly and disturbs its finely adjusted physiological balance; and (3) primary splenic panhematopenia on a congenital or familial basis. Complete data from the adrenalin test and careful sternal marrow aspiration analyses should provide the information on which to base an opinion and advise therapy. Splenectomy in the first two mechanisms may result in a more or less temporary and abortive remission of the symptoms and signs related to the disturbed cellular balance, and it may or may not influence the fundamental underlying disease; but in the last named syndrome, in which the spleen apparently is primarily at fault, a prompt, complete, and permanent re-equilibration, both hematological and clinical, may be anticipated and predicted with some assurance.

JOHN L. LINQVIST, M.D.

## MISCELLANEOUS

Moore, M. T.: Paroxysmal Abdominal Pain. *J. Am. M. Ass.*, 1945, 129: 1233.

In cases of abdominal pain without a demonstrable organic or psychogenic cause, a study should be directed to the possible existence of cerebral disease or dysfunction. Exact localization of cerebral representation of gastrointestinal activity and abdominal pain is still not fully determined, but most data point to cortical mediation and possibly diencephalic influence.

From the clinical approach, abdominal pain has been postulated as being a form of epileptic variant. Fits of varying forms, including abdominal pain, may result from a host of conditions producing either structural or physiological changes in the brain. Wechsler stated: "I would call attention to the occurrence of abdominal pain, at times simulating appendicitis, renal colic, gallbladder disease, and gastric or duodenal ulcers, in tumors of the brain. I have seen patients treated for a long time and even operated upon for abdominal syndromes which were the harbingers of brain tumors."

The author presents 6 cases which constitute a group of individuals in whom abdominal pain was the only symptom (or an outstanding one) present and unrecognized over a considerable length of time, and in whom thorough history taking, detailed neurological examination, and utilization of diagnostic aids, including electroencephalography, led to the consideration of the pain as a manifestation of focal symptomatic epilepsy.

The 6 cases presented have a common denominator: abdominal pain. In 2 cases this happened in practically a pure form, and in 1 case the predominant seizures consisted of abdominal pain occurring in wavelike attacks. These 3 cases had been studied quite intensively before the diagnosis of abdominal epilepsy was entertained; 2 of the patients showed

abnormal electroencephalographic findings. All 3 patients responded immediately and continuously to anticonvulsant therapy in the form of dilantin and bromides or phenobarbital.

Three of the 6 patients had a history of antecedent head injury. One presumably had cerebral angioneurotic edema following the injection of diphtheria antitoxin, with a sensitization or morbid change in the cerebral cortex, and 1 had tuberculous sclerosis with undoubted morbid changes in the brain. No etiological background could be revealed in the sixth case. Thus, the majority of cases presented give evidence of disturbed cortical structure and function.

The 5 patients who were given anticonvulsants responded favorably and quickly to the use of dilantin alone or in combination with phenobarbital or bromides. Two patients in whom electroencephalograms were made before and during treatment with dilantin and phenobarbital demonstrated the damping out effect, by these anticonvulsants, of the abnormal cerebral discharges.

In 3 of the 6 cases, the patient gave a history of head injury. This, as a possible cause of abdominal epilepsy, is considered important at this time because of a strong likelihood of many cases of epilepsy or its variants finding their way into medical practice as the result of craniocerebral injuries and infections incident to World War II, and those which may appear with the return of the automobile and airplane to extended civilian use.

The criteria for diagnosis are based on (1) exclusion of intrinsic visceral disease, (2) adequate historical data, (3) attack pattern of an epileptic order, (4) associated epileptic show, (5) objective evidence of cerebral organic disease or dysfunction, and (6) the effect which anticonvulsant drugs produce on the symptom of abdominal pain and on the electroencephalogram.

DOUGLAS R. MORTON, M.D.

# GYNECOLOGY

## UTERUS

Scheffey, L. G.: *Diagnosis and Management of Uterine Carcinoma and Sarcoma. Surg. Clin. N. America*, 1945, 25: 1262.

A review of pelvic malignancies is presented. The author notes that carcinoma of the cervix is no respecter of the so-called cancer age, and that 27 per cent of cancer patients seen at the Jefferson Clinic, Philadelphia, were under 40 years of age. He advocates the use of biopsy on all suspicious lesions, and the necessity, in many cases, of splitting the cervix for a more careful inspection. The vaginal smear technique is used in his clinic, but it is admitted that a long period of training is necessary before one can be proficient in identifying abnormal cells which are characteristic of malignancy.

The author reviews the management of carcinoma of the cervix, and compares the results obtained from use of the radical Wertheim operation with those obtained from irradiation. He quotes statistics from many clinics which have used one or both methods, and concludes that irradiation is the treatment of choice in the great majority of cases. In the Jefferson Clinic the survival rate, based on a 5 year follow-up, was 47 per cent for early cases and 23.5 per cent as an over-all rate. The technique employed at the Clinic is discussed in detail and the use of deep roentgen rays through 4 external ports, combined with the transvaginal port, is favored. A massive dose treatment with radium follows the deep x-ray treatments.

The occurrence of carcinoma in the cervical stump following supravaginal hysterectomy is estimated at approximately 1 per cent, and the treatment of choice is irradiation. Carcinoma of the cervix in association with intrauterine pregnancy is noted as a combination of rare occurrence, with an estimated incidence of 1 case in 10,000 pregnancies. The use of biopsy is recommended, and precedence is given to management of the carcinoma over the possibility of obtaining a live baby.

The incidence of carcinoma of the fundus in patients under 40 is rare, and figures from the Jefferson Clinic place their average age at 59. The use of natural and synthetic estrogens in the management of symptoms of the menopause has frequently confused the diagnostic picture in postmenopausal bleeding, and stress is placed on the fact that diagnostic curettage is necessary when bleeding occurs. The author's management of fundal carcinoma is preliminary irradiation followed by total hysterectomy and extirpation of the adnexa in every patient who can tolerate surgical procedures.

It is estimated that sarcoma of the uterus occurs in approximately 3 per cent of all uterine malignancies. The treatment and prognosis is generally accepted to be unsatisfactory.

GEORGE BRADBURN, M.D.

Cirio, C. R.: *Myometrectomy (Miomectomia)*  
*Obst. gin. lat. amer.*, B. Air, 1945, 3: 761.

In the treatment of myoma of the uterus the type of operation should be fitted to the conditions encountered in the individual, with avoidance of any tendency at systematization. The author, in fact, cites a number of operations which might be resorted to on occasion, and arranges them in order from the most conservative to the most radical. The list begins, of course, with polypectomy and curettage, continues with enucleation or myomectomy by the abdominal or vaginal routes; then comes the fundal amputation of Passeron and Beutner, and finally, he mentions his own operation, or myometrectomy. Four other types of operation, the partial amputations of the body of the uterus according to Aschner and Risolia; the hysteromyomectomy of Maurity Santos; the high, subtotal, and the low, subtotal hysterectomies, the latter combined with the implantation of endometrium in the stump, close his list of operations aimed at preserving the function of menstruation. Finally, the list contains, as most radical and sacrificing the menstrual function, the operations of low, subtotal hysterectomy without implantation of the endometrium, and total hysterectomy.

For myometrectomy the author not only claims the preservation of the menstrual bleeding itself, but further asserts that this operation will not hinder the synergism which exists between the endometrium and ovary. This is not solely due to the preservation of the endometrium but to the method of first loosening carefully from the uterus the broad ligament in its entirety before proceeding with the operation of amputating the upper part of the corpus uteri.

As for the technique of myometrectomy, it is briefly described in French in *La Presse Médicale* (1940, No. 90) and in Spanish in the *Journal of the International College of Surgeons* (1942, No. 6). Excellent photographs and diagrams render the general character of the operation obvious. Essentially, the operation is a vaginal amputation through the body of the uterus, followed by excision of the muscular wall of the uterus between the endometrium and perimetrium of the stump as far as the cervix; and perimetrium of the stump as far as the cervix; the inner tube of endometrium, with perhaps some attached muscular tissue, and the outer tube of perimetrium are left as intact as conditions permit. The two tubes are now intimately applied and sutured to one another and then the outer or so-called myometrial tube is closed across the top to leave the serosal tube is closed toward the vagina. Finally, the draining downward toward the vagina. Finally, the carefully preserved stumps of the broad ligaments are included in the remaining peritoneal flaps and the whole is sutured over the remaining uterine stump, the so-called peritonization.

Follow-up examinations usually show that the cavity of the child sized residual uterus is about 4 cm. in depth, and although pregnancy is excluded, as a rule the woman menstruates at her regular intervals and with almost normal abundance. In fact, 1 patient later developed a menorrhagia, which, however, proved to be the subsequent growth of a myoma of the cervix from an area so deep that it could not be reached by the operation itself. It is obvious, of course, that this operation should not be done on younger women (below 40 years of age) unless they have already satisfactorily fulfilled their rights and duties as a mother, nor on older women (above 48 years of age) who are already entering or have entered the menopause. Again, the bleeding in this operation, although not serious, is nevertheless a factor which requires a quick, deft procedure, and the method should not be attempted by other than an adept.

The author's material now includes 141 operations with a follow-up on 91; in 12 (13%) menstruation has not returned, while in 79 (87%) it has reappeared; however, in a new group of 48 patients operated upon there has not been a single instance of amenorrhea. These last excellent results are attributed by the author to the perfecting of his technique, especially the separating of the inner or myomucosal tube by means of the bistoury, and rejecting the electric knife for this part of the operation, as well as the careful preservation of the broad ligament with regard to its blood supply and innervation, which permits a more perfect functioning of the synergistic relationship existing between the ovary and the endometrium.

The author's statistics, which are the most important recorded up to the present time, give a mortality for myometrectomy of only 1.41 per cent.

JOHN W. BRENNAN, M.D.

#### ADNEXAL AND PERIUTERINE CONDITIONS

Magnusson, W.: Roentgen Diagnosis of Tuberculous Salpingitis (Ueber das Röntgenbild bei tuberkulöser Salpingitis). *Acta radiol.*, Stockh., 1945, 26: 265.

As a rule uterosalpingography is not considered to be a diagnostic method by which inflammatory lesions of the fallopian tubes such as gonorrheal, tuberculous, and nonspecific salpingitis can be distinguished from each other. The only exceptions are salpingitis isthmica nodosa and endometriosis of the tubes.

The author studied the roentgen findings in 12 histologically proved cases of tuberculous salpingitis and compared them with films obtained in 200 cases of tubal occlusion caused by tuberculosis and various other conditions. The nonpatency of the tubes was demonstrated in all cases of both groups by 24 to 48 hour follow up films taken in the erect position for visualization of the fluid levels. These films showed retention of the contrast material (perabrodil or iodized oil) in the tubes.

In 9 cases of the first group irregularly serrated, ragged contours of the visualized tubes were found to be associated with from pin head to rice kernel sized intraluminary filling defects. Three cases displayed destruction of the tubal wall with abscess and fistulalike dilatations of the tubes. The 24 hour films showed retention of the contrast material in irregularly shaped saccular pools in 6 cases, most of them containing fluid levels.

The author concludes that the roentgen diagnosis of tuberculous salpingitis is possible in many cases since the described findings are rare in other forms of salpingitis.

GERIART S. SCHWARZ, M.D.

Spangler, C. M.: Operations for Sterility. *Surg. Clin. N. America*, 1945, 25: 1345.

The author states that the surgical approach to the problem of sterility in the woman of childbearing age may be successfully followed in some instances. If possible, the cause of the sterility is ascertained, following which a test for tubal patency is made. Surgery is never attempted in the presence of acute or subacute pelvic infection.

The choice of operative procedure depends upon the location of the obstruction. In extensive tubal obstruction, the Estes or the Tuffier operation must be performed. The former consists in the excision of the uterine cornu and the attachment of the denuded surface of the ovary to the exposed ostium, care being taken to preserve the blood and nerve supply. The Tuffier operation consists in making an opening in the posterolateral wall of the uterine cavity, into which the ovary is projected. The incidence of pregnancy following these operations is about 8 and 4 per cent respectively.

The Bonney operation is used in cases in which the obstruction lies in the outer third of the tube. It consists of an amputation proximal to the site of the occlusion, testing the tube for patency, placing a No. 9 catheter in the outer third of the tube, and a Bonney clamp over the tube and catheter 1.5 to 2.5 cm. from the amputated end. A circular incision is made at the end of the clamp through the muscularis, and the mucosa is everted, bringing it onto the serous coat. The ovary is then suspended to the lateral pelvic wall.

Obstruction in the proximal or medial portion of the tube offers the greatest opportunity for success. A modified Holden technique is used where the oviduct is divided distal to the site of obstruction, and the closed portion is then freed from its broad ligament attachment. The uterine cornu is excised and the patent end of the tube is inserted.

Postoperative treatment consists of a Rubin insufflation in from 10 to 14 days. At the end of 6 weeks, 92 per cent of the patients in this series exhibited patent tubes. CATHERINE B. HESS, M.D.

Knight, R. van Dyck.: Tubal Sterilization. *Am. J. Obst.*, 1946, 51: 201.

Two hundred and thirty-three tubal sterilizations performed during a 10 year period are reviewed by

the author in an effort to determine which type of operation offers the highest incidence of success. The Pomeroy sterilization is a safe, simple, sure, and rapid procedure. The reported failures of this operation are 50 per cent fewer than those for the Madlener sterilization.

The Pomeroy sterilization avoids mechanical and biological hazards which are inherent to other types of tubal sterilization. EDWARD L. CORNELL, M.D.

Dionisi, H., and Ferraris, L. V.: Ovarian Struma with Hyperthyroidism (Struma ovarica con hipertiroidismo). *Obst. gin. lat. amer.*, B. Air, 1945, 3: 797.

A woman of 46 years, who had had 4 normal pregnancies and deliveries, had been undergoing rather satisfactory treatment for diabetes for 5 years when she began to lose weight and strength, and developed tremor, exophthalmos, and an enlarged thyroid gland. Her basal metabolism varied between +37 and +54 but after subtotal thyroidectomy it dropped to +12, the symptoms of hyperthyroidism disappeared, and the patient gained 10 kgm.

Two years later the patient again sought medical advice, having been suffering again from nervousness for about 6 months. At this examination there was observed a distinct exophthalmos, tremor, and some muscular hypotonia. No enlargement of the residual thyroid tissue in the neck could be determined, nor could any aberrant thyroid glands be found. However at vaginal examination a spherical tumor, the size of an orange, could be felt to the right of the uterus. The diabetes could be controlled adequately with insulin, but the other symptoms continued in spite of iodization, the basal metabolism measuring +52 10 days later.

The ovary seemed to be involved in the tumor mass and the whole was removed under local anesthesia with .50 per cent novocain. A month later the metabolism was down to +8. A year later the patient was in perfect health and had gained 12 kgm.

Histological examination exhibited the usual lack of uniformity for tumors of this sort, that is, there were areas which very much resembled a colloid goiter, others simulating the typical Basedow picture, and, finally, still other areas suggesting the fetal type of parenchymatous hyperplasia. Scattered about were remnants of the original ovary.

Although the authors were not in a position to conduct special chemical or biological investigations, they believe that in view of the clinical picture and the morphologic aspect of the tissues there can be no doubt that the thyrotoxic picture was occasioned by the ovarian struma. JOHN W. BRENNAN, M.D.

#### EXTERNAL GENITALIA

Rodríguez, F. V.: Some Lesions of the Vulva (Sobre algunas lesiones vulvares). *An. brasil. gin.*, 1945, 20: 271.

A statistical review of the cases seen in the Gynecological Clinic of the National School of Medicine

at Rio de Janeiro over the 10 year period from 1935 to 1945 is given. Ninety-three lesions were encountered among 3,180 hospitalized cases, and 221 lesions among 6,020 out patients. Some patients were included in both groups, but in order of frequency disease of the Bartholin glands was the most common, followed by luetic manifestations, and other types of ulcers, dystrophies, and neoplasms. Neoplasms were seen in .9 per cent of the out patients and 6.45 per cent of the in patients. Mycotic infections were seen in 2.21 per cent of the out patients.

A tabular list of the various lesions in both groups is given in the original article and is accompanied by illustrative photographs. One case of cylindroma is presented. HIRAM T. LANGSTON, M.D.

#### MISCELLANEOUS

Lang, W. R.: Blood, Blood Derivatives, and Blood Substitutes in Obstetric and Gynecologic Practice. *Surg. Clin. N. America*, 1945, 25: 1485

Lang, in a survey of blood, its derivatives and its substitutes, stresses the use of such products in the practice of obstetrics and gynecology where so many acute emergencies necessitate immediate and efficient restoration of blood volume and oxygen carrying capacity to the patient. The various parenteral routes of administration are discussed, and the author favors the intravenous and intramedullary routes.

Often, not enough whole blood is used, and it is believed that the response on the part of the patient, rather than the volume of blood administered, is the best indicator. The use of plasma and other substitutes is but a temporary measure in the treatment of acute blood loss.

The author summarizes the importance of the Rh factor in hemolytic transfusion reactions, in certain complications of pregnancy, and in neonatal anemias. He believes that in the administration of red cell suspensions to replace lost cells, those of Rh negative donors (even though the plasma of such donors contain anti-Rh antibodies) may safely be given to erythroblastotic infants, or to the mothers of such children.

The various colloidal plasma substitutes are listed and discussed. The author apparently favors the use of albumin and ascitic fluid.

GEORGE BRADBURN, M.D.

Greene, R.: D.B.E.: A New Synthetic Estrogen. *Brit. M. J.*, 1946, 1: 9.

D.B.E. ( $\alpha$ -di-( $p$ -ethoxyphenyl)- $\beta$ -phenyl bromoethylene) is a new synthetic estrogen which is absorbed from the alimentary tract, but differs from other orally active estrogens in having a prolonged action, whether it is given by mouth or injection.

In 6 patients suffering from the vasomotor symptoms of the climacteric, satisfactory relief was obtained with an initial dose of 1 or 2 gm., followed by a maintenance dose of from 100 to 300 mgm. once weekly. Less satisfactory results were obtained in 3

cases of uterine atrophy. D.B.E. was ineffective in controlling carcinoma of the prostate in 3 cases.

HENRY C. FALK, M.D.

Way, S.: D.B.E. in the Treatment of Menopausal Symptoms. *Brit. M. J.*, 1946, 1: 10.

D.B.E. ( $\alpha$ -di-( $p$ -ethoxyphenyl)- $\beta$ -phenyl bromoethylene) is a synthetic estrogen with a prolonged action. This substance was used to relieve menopausal symptoms in 11 patients who had undergone surgical or radiological castration: 5 were completely relieved, 3 were greatly relieved, and 3 showed no response. The dosage required for the relief of these symptoms is an initial dose of 2 gm., followed by a maintenance dose of 0.2 gm. weekly. Mild cases may require only half this dosage. The side effects of other synthetic estrogens have been noticed with D.B.E.

It appears from this small series that D.B.E. is probably not as effective as stilbestrol in the relief of menopausal symptoms. It is probable that its sole advantage is that it needs to be administered infrequently and not daily, as with other synthetic estrogens.

HENRY C. FALK, M.D.

Rubin, I. C.: Therapeutic Aspects of Uterotubal Insufflation in Sterility. *Am. J. Obst.*, 1945, 50: 621.

The extent to which some degree of patency can be produced by tubal insufflation alone or by any additional measures, such as diathermy treatment or the more potent hormonal extracts, will determine the conceptional possibilities in women whose sterility is traceable chiefly to tubal pathology. It was with this object in mind that the author made the following statistical analysis in 590 personal cases of pregnancy preceded by uterotubal insufflation.

**Primary versus secondary sterility.** In the author's personal series there were 2,014 patients with primary sterility. Of these, 358 (17.77%) became pregnant. There were 1,186 patients with secondary sterility, of whom 232 (19.56%) became pregnant.

One hundred and forty-six of the patients who became pregnant were between the ages of 20 and 25 years, and 250 were between the ages of 25 and 30 years. One hundred and eighty-four patients (31.19%) were 30 years of age or over when they sought relief; of these, 34 were between the ages of 35 and 40 years, and 6 were over 40 years old.

In 7 of the successful cases with high grade strictures, lipiodol also was employed. In 3 cases, insufflation had been done once before lipiodol was employed; in 3 cases insufflation had been done 3 times, and in one case, 4 times. In 4 of these cases insufflation also followed the lipiodol injection—once in 2 cases, 4 times in 1 case, and 7 times in the fourth case before pregnancy ensued. The therapeutic efficacy of lipiodol in these 7 cases is difficult to appraise because 29 insufflations altogether had been done before or after the 7 single lipiodol injections.

TABLE I.—TUBAL STATUS IN 590 PATIENTS WHO BECAME PREGNANT

	Number of Cases	Number of Pregnant Cases	Percentage
Normal patency . . . . .	1,210	316	26.12
Adherent tubes . . . . .	538	135	25.09
Strictured tubes . . . . .	379	118	31.13
Spasm and normal patency . . . . .	134	21	15.74
Total . . . . .	2,261	590	98.08

TABLE II.—THE EVENTUALITY OF PREGNANCY IN 517 CASES

	Number of Cases	Percentage
Term babies only—born alive . . . . .	383	74.08
Premature babies—born alive . . . . .	4	.77
Premature and term babies—born alive . . . . .	4	.77
Premature and incomplete abortions . . . . .	2	.39
Stillbirth at term . . . . .	2	.39
Stillbirth . . . . .	2	.39
Spontaneous abortions . . . . .	81	15.67
Spontaneous abortions and term babies . . . . .	26	5.03
Tubal pregnancy—born alive . . . . .	9	1.74
Tubal and term pregnancies—born alive . . . . .	4	.77
Total . . . . .	517	100.00

Of the 590 patients who became pregnant, 11 were treated with small doses of radium for delayed and scanty periods, and 1 patient received a larger dose for menometrorrhagia. Eight of the 12 patients became gravid within 1 year of the use of radium, and 4 within the first 6 months. Similarly, 29 patients had received x-ray and insufflation therapy before becoming gravid.

Three hundred and seventy-eight, or 64.07 per cent, of the pregnancies occurred within the first 6 months of the test; 108 pregnancies occurred within the second 6 months.

Ninety-four patients who became pregnant following insufflation subsequently encountered renewed difficulty in conceiving. Another insufflation was again succeeded by pregnancy.

EDWARD L. CORNELL, M.D.

Siegler, S. L.: The Value of Physiological Substrates in Sperm Migration in Selected Cases of Human Infertility. *Am. J. Obst.*, 1946, 51: 13.

It does not appear improbable that the use of a Ringer glucose precoat irrigation, at the most favorable period, makes several real contributions toward increasing the possibilities for sperm migration by furnishing additional sugar and isotonic electrolytes for stimulation of the cellular metabolism and motility, through promotion of a propitious pH of the mixture of vaginal secretions, by altering the viscosity of both the distal cervical mucus and the male ejaculate in the presence of a favorable isotonic substrate, and by providing a less abrupt metabolic shock for the spermatozoa.

When one considers the manifold aspects which can alter the surface substrates and glucose levels of

the semen in the vaginal secretions, it becomes more obvious that Ringer glucose isotonic solution used as a precoital irrigation merits a definite place in the armamentarium of the physician confronted with infertility problems.

The application of these important animal husbandry and preclinical laboratory observations for the relief of human infertility, in carefully selected cases, is discussed. In 106 couples giving a history of from 1 to 14 barren years, Ringer glucose isotonic solution was used precoitally as a vaginal irrigation, and the author is able to report 29 successful conceptions, a salvage of 28.3 per cent from this group of infertile patients.

EDWARD L. CORNELL, M.D.

**Sampson, J. A.:** The Pathogenesis of Postsalpingectomy Endometriosis in Laparotomy Scars. *Am. J. Obst.*, 1945, 50: 597.

Seventeen cases of laparotomy scar endometriosis were studied. The first operation, in all but 1 case, consisted of bilateral salpingectomy or tubal sterilization followed by intentional or accidental ventrofixation of the uterus. In the 1 case in which salpingectomy had not been done, the scar endometriosis followed a myomectomy. In all but 1 of the 16 postsalpingectomy cases, the scar, together with the uterus, was removed at the second operation. In this 1 case the endometriosis, apparently fused with both uterine cornua, was so extensive that only a portion of it and the remaining ovary were removed. In all but 2 of these 15 specimens the scar endometriosis was fused with a uterine cornu. In 1 of these 2 cases the fundus was not in actual contact with the wound at the close of the first operation but the left cornu became connected with the scar by the remains of a long drainage tract. In the other case the scar endometriosis was fused with the center of the fundus and not with either uterine cornu, although stump endometriosis was present in both cornua. In this case the scar endometriosis was derived from the mucosa of the fundus by continuous invasion in the attempted repair of an evident rent

in the uterine wall, probably caused by a ventrofixation suture which had penetrated the uterine cavity.

Endometriosis was found about the tubal stumps in the 13 uterine cornua which were adherent to the scar endometriosis, as well as in the cornu not in actual contact with the scar but connected with it by a long drainage tract. It was present about the tubal stumps in both cornua in 11 of these 14 uteri, but in only 1 instance had the endometriosis in both cornua invaded the scar and produced 2 foci of endometriosis in it. In the remaining 10 cases, the scar endometriosis was derived from only one tubal stump, and that about the other stump was confined to the cornu itself.

The scar endometriosis was derived from the mucosa of a tubal stump by continuous invasion in 10 specimens. It probably arose in a similar manner in 3 others. In 2 additional specimens such an origin could not be excluded although in 1 the endometriosis might have been of transplantation origin and in the other, secondary to a possible peritoneal endometriosis of the uterine cornu. Transplantation endometriosis was possibly present in 3 scars.

An interesting feature of postsalpingectomy endometriosis is that the ectopic mucosa, which can be shown to have had its origin in the mucosa of a tubal stump and to have grown from it by continuous invasion, may not only retain the structure of the tubal mucosa, thus being actually an endosalpingosis, but may also assume both the structure and function of the uterine mucosa, including its reaction to menstruation and pregnancy, and thus produce true endometriosis.

Mucosa of the uterine type was present in all of the specimens of postsalpingectomy scar endometriosis. In some specimens the endometriosis of the uterine cornu, which was proved to have been derived from the mucosa of the intramural part of the tube, was definitely of the tubal type. However, after these tubules had penetrated the scar, typical uterine mucosa appeared in and about them.

EDWARD L. CORNELL, M.D.

# OBSTETRICS

## PREGNANCY AND ITS COMPLICATIONS

Scott, W. A.: *Selective Treatment of Antepartum Hemorrhage*. *Am. J. Obst.*, 1946, 51: 48.

Selective treatment of 191 cases of placenta previa resulted in a mortality of 2.6 per cent, and of 139 cases of accidental hemorrhage in a mortality of 2.9 per cent.

These results are comparable to those obtained by routine section in the treatment of these conditions and may avoid the additional risk of subsequent pregnancies in patients who have undergone cesarean section.

All cases of antepartum hemorrhage should be treated in the hospital, if at all possible, but as the diagnosis cannot always be accurately made when the first bleeding is only slight, this will entail the hospitalization of patients who may subsequently be proved to have neither placenta previa nor accidental hemorrhage.

In most emergencies of medical practice, when special skill is not available, conservative measures of treatment are usually in the best interests of the patient, but if skilled judgment is not available in placenta previa and probably in accidental hemorrhage, a radical method of treatment, namely cesarean section, is probably advisable.

EDWARD L. CORNELL, M.D.

## LABOR AND ITS COMPLICATIONS

Hingston, R. A.: *The Control of Pain and Fear in the Management of Labor and Delivery*. *Surg. Clin. N. America*, 1945, 25: 1352.

The author presents an evaluation of the most commonly used analgesics in labor with particular emphasis on the necessity for controlling pain and fear. Since Pearl Harbor Day, 1941, approximately 12,000,000 babies have been born in the United States, with an estimated annual loss of 624,000 babies at birth or during the first year of life. This far exceeds our losses due to war.

The physician should devote more attention to the protection of the obstetrical patient from pharmacologic intoxication or overdosage of the analgesic drugs while attempting to provide control of the pain, and should use more psychology in the management of labor and delivery. No one single agent or method is suitable for every case.

Pain relief in obstetrics can be attained only in hospitals where there is teamwork among the obstetrician, anesthetist, and nurse. At the present time in the United States there are seven methods commonly used. The most popular, used in 60 per cent of deliveries, is the use of the barbiturates. The second is the use of chloroform and open drop ether. The third is the use of nitrous oxide oxygen analgesia with labor pains; the fourth, the use of rectal anal-

gesia with either paraldehyde or ether, or both. Within the past three years caudal analgesia has moved up to fifth place. The author personally supervised 5,000 labors and deliveries under caudal analgesia. The recent introduction of demerol as an agent has provided the means of combining it with scopolamine or the barbiturates and this agent ranks sixth place. In seventh place are local perineal infiltration, and spinal, paravertebral and peridural block.

Several methods for amnesia were reported upon by various obstetricians; the use of scopolamine was discussed by Royster. This consists of giving from 3 to 4½ gr. of nembutal, plus 1 c.c. (1/130 gr.) of hyoscine hydrobromide. Forty-five minutes after the initial dose another cubic centimeter of hyoscine is given, and in another 45 minutes 0.5 c.c., and this is repeated every 1½ to 2 hours.

Scopolamine is also administered very successfully in combination with morphine, demerol, and the barbiturates.

Rudolph submitted a method for rectal analgesia. A soda bicarbonate enema is given first. When the pains are hard and regular, from 4½ to 6 gr. of nembutal are given, and when the patient becomes restless again ether (ether 2½ ounces, paraldehyde, 2 drachms, olive oil, q.s. 4 ounces) is given rectally. The safety of rectal ether analgesia in obstetrics is one of its greatest advantages.

It is also noted that paraldehyde can be given by mouth, the dose being about 20 c.c. Port wine is used as a vehicle. Paraldehyde plus 1.5 c.c. of benzyl alcohol can be instilled into the rectum.

Caudal analgesia is discussed as a technique to produce total analgesia without amnesia or anesthesia. The agent recommended is 1.5 per cent metycaine in isotonic solution of the three chlorides. A trial dose of 8 c.c. is given to eliminate the danger of intraspinal injection. Satisfactory relief was obtained in 92 per cent of 3,000 cases at the Philadelphia Lying In Hospital. Three maternal deaths occurred: the first was due to intraventricular hemorrhage, the second to unexplained hyperpyrexia (in a toxemic multipara with inadequately treated syphilis), and the third to exacerbation of an endocarditis.

Siever reported that continuous drip caudal analgesia was advantageous because: (1) the chance of infection was decreased, (2) the level of anesthesia was constant, (3) there was more uniform pressure within the caudal canal, and (4) the total amount of anesthetic required was decreased.

Continuous spinal anesthesia was also mentioned for use in selected cases. From 25 to 50 mgm. of 2 per cent procaine or from 15 to 30 mgm. of 1.5 per cent metycaine are used. This is the one method which, when properly administered, absolutely protects the baby from transplacental intoxication.



In controlling fear in labor a quiet, soundproof room with cheerful furnishings is essential. Caudal analgesia allows the patient to relax, read, and to enjoy her surroundings. This technique has returned to womanhood the experience of hearing her baby's first cry, which she previously had to sacrifice. Thus in modern obstetrics the babies can and must be spared placental narcotization.

CATHERINE B. HESS, M.D.

Ricci, J. V., and Marr, J. P.: The Physick-Sellheim Principle of Extraperitoneal Cesarean Section. Elucidation of a Technique Based on 175 Cases. *Am. J. Surg.*, 1945, 71: 3.

The author's technique of extraperitoneal cesarean section is described in detail. This operation was performed in 175 cases, including "clean" as well as potentially or actually infected women, with 1 maternal death and 7 fetal deaths. The bladder was injured on 6 occasions; in all instances repair was followed by an uneventful recovery.

After examination and dislodgment of the impacted fetal head, the bladder is catheterized and the catheter removed. A completely empty bladder facilitates the operation and reduces bladder injury to a minimum. With the patient in moderate Trendelenburg position, a symmetrical  $5\frac{1}{2}$  inch Pfannenstiel incision is made, the aponeurosis of the recti and oblique muscles incised, the median raphe of the recti muscles cut, and the recti muscles are separated from the underlying transversalis fascia.

The bladder lies beneath the transversalis fascia and is completely enveloped (anteriorly and pos-

teriorly) by the vesical fascia. Finger massage of the bladder and its fascial coats helps to contract the bladder and loosen this viscus from its fascial capsule (Fig. 1).

The fascia transversalis and anterior vesical fascia are grasped with two curved Kelly clamps 1 inch below the bladder dome in the midline, and incised between these two clamps (Figs. 2 and 3). All laminations of the fasciae are cut down to a layer closest to the musculature of the bladder. This opening is enlarged laterally to permit the intrusion of the index finger or Kelly clamp, and the liberated fasciae are incised arclike, in a curve down to Poupart's ligament, to expose the right paravesical fossa. The urachus, if fibrous, must be cut with care.

The right paravesical fossa is further exposed by careful and vigorous retraction to exhibit the lateral wall of the bladder, the outermost portion of the peritoneal reflection, and the fascia uteri. The bladder is displaced laterally and downward toward the symphysis. The transparent fascia uteri is incised just below the peritoneal fold to permit insertion of the index and middle fingers (Figs. 4 and 5). By finger dissection from right to left, the bladder is separated and elevated to reveal the edge of the peritoneal fold, the dome of the bladder, the fascia uteri, and the posterior vesical fascia (the two fasciae as one structure). The fasciae are incised with scissors between the dome of the bladder and the peritoneal fold from the right to the left side of the bladder to uncover the lower uterine segment.

A 3 inch crescentic incision is made into the lower uterine segment and stay sutures are inserted to

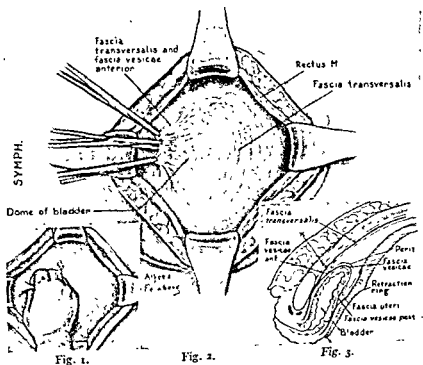


Fig. 1. Finger massage of flattened, empty bladder. This procedure helps to contract the anesthetically relaxed bladder musculature and to loosen viscus from fascial capsule.

Fig. 2. Grasping and incising of the fascia transversalis and fascia vesicae anterior 1 inch below bladder dome, exactly in midline. Both fasciae are laminated. Terminal lamination on the bladder musculature is left to facilitate decapsulation and protect vesical vessels.

Fig. 3. Peritoneal and fascial relationships to the bladder and lower segment exactly in the midline. Cross (x) indicates the point of incision of the fascia transversalis and fascia vesicae anterior as portrayed in Figure 2.

Fig. 4. The paravesical fossa (right) is exposed to present the lateral wall of bladder, the end of the posterior peritoneal fold, and the fascia uteri. The posterior peritoneal fold lies between the posterior vesical fascia above, and the fascia uteri below.

Fig. 5. The relationship of the fasciae to the displaced bladder and posterior peritoneal fold in the midline. Cross (X) indicates the area where the fascia uteri is incised to liberate the lower segment from the fascial covering and permit upward retraction of the peritoneal fold.

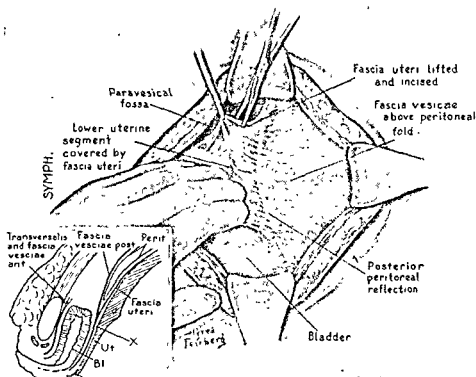


Fig. 5.

Fig. 4.

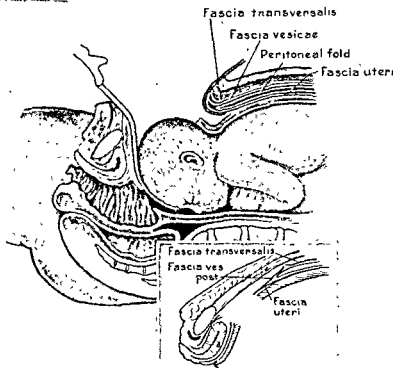


Fig. 6.

Fig. 7.

Fig. 6. Vertex in the anteroposterior position with the solid obstetrical blade in place over the brow. Delivery is facilitated by fundal pressure exerted against the obstetrical blade.

Fig. 7. The relationship between the cut fascia, bladder, and cut surfaces of the lower segment. Diagrammatic representation of Figure 6. (Courtesy of American Journal of Surgery.)

serve as guides and for hemostasis (Figs. 6 and 7). All retractors are now removed and the fetus is delivered by a solid obstetrical blade or version. The delivery of the placenta is preceded by the use of pituitrin and ergotrate. The uterus is packed with iodoform gauze and the incision closed with two

layers of No. 0 chromic sutures. The bladder is elevated to its original position. The transversalis fascia is coated with interrupted sutures. Sulfanilamide powder is sprinkled in the operative field and a rubber tissue drain is inserted.

GEORGE BLINICK, M.D.

Ullery, J. C.: Continuous Spinal and Continuous Caudal Analgesia in Cesarean Section. *Surg. Clin. N. America*, 1945, 25: 1382.

The marked narcosis of babies delivered under inhalation anesthesia and heavy drug sedation has been one of the highest causes of infant mortality. This report shows the indications, technique, and advantages of continuous caudal and spinal anesthesia for cesarean section as a means of eliminating this narcosis.

The advantages of continuous spinal anesthesia are as follows:

1. A smaller initial dose is used. Thus any untoward toxic symptoms will be minimal, and most of the drug can be rapidly withdrawn.
2. The anesthesia is easily controlled.
3. The ease of administration and speed is advantageous.
4. There is a definite decrease in postoperative complications.
5. An excellent contraction of uterine musculature occurs.
6. There is an absence of narcosis in the infant.
7. Excellent abdominal relaxation is present.

The technique consists in giving  $1\frac{1}{2}$  gr. of barbiturate an hour before operation. The needle is inserted between the first and second, or second and third lumbar interspaces. Eight cubic centimeters of fluid are withdrawn and mixed with the anesthetic agent and reinjected. This agent is usually from 25 to 40 mgm. of procaine. The level is maintained by the further injection of from 0.5 to 1 c.c. of procaine. The blood pressure, pulse, and respirations are taken every 5 minutes. If the systolic level falls to 90 mm. or less,  $\frac{3}{4}$  gr. of ephedrine hydrochloride is given intramuscularly, or glucose solution or plasma is given intravenously. After the baby is extracted  $\frac{1}{4}$  gr. of morphine is given hypodermically. Following the delivery of the placenta, ergotrate is given intramuscularly. At the completion of the operation, the remaining drug is partially removed by the aspiration of from 1 to 2 c.c. of spinal fluid.

A contraindication to this type of analgesia is the patient who is in poor condition because of severe hemorrhage.

The advantages of continuous caudal anesthesia are practically the same as those of spinal anesthesia. It is also particularly valuable in patients with cardiac or respiratory disease, and in patients who may have had an initial test of labor under caudal anesthesia and in whom the need for section arises. In severe toxemias in which cesarean section is required, the symptoms and blood pressure elevation are alleviated during and following operation.

The contraindications are listed as follows: (1) gross deformities of the spine, (2) tumors which narrow the spinal canal, (3) local infection around the sacral hiatus, (4) a history of sensitivity to the anesthetic agent, (5) profound anemia or shock, (6) placenta previa, and (7) hysterical patients.

The safety, controllability, speed, and ease of administration of spinal analgesia make this an

outstanding analgesia in the obstetrical armamentarium. Continuous caudal analgesia offers the same safety to the child and mother although it requires a specially trained anesthesiologist for its administration and supervision. KATHERINE B. HESS, M.D.

## NEWBORN

Rothe-Meyer, A., and Hickmans, E. M.: Decrease of the Serum Cholesterol Ester in Hemolytic Disease of the Newborn. *Arch. Dis. Childh.*, Lond., 1945, 20: 160.

It has long been recognized that jaundice occurring in hemolytic disease of the newborn cannot be explained as a pure hemolytic icterus. The severity of the jaundice, the positive Van den Bergh reaction, and the pathological changes in the liver all point to a toxic injury of the liver. Furthermore, some cases are associated with "kernikterus" or with the late development of cirrhosis.

It is well known that the serum cholesterol and its partition may exhibit characteristic changes in diseases of the liver. Obstructive jaundice is characterized by a hypercholesterolemia, affecting both the free and the ester fraction, which parallels the degree of hyperbilirubinemia. On the other hand, in acute parenchymatous degeneration, especially toxic and infectious hepatitis, the values for total cholesterol are normal, or slightly subnormal, and show no relationship to the bilirubin values. The outstanding change is the lowering of the ester fraction, which mirrors the severity of the liver damage. In the severest cases the ester fraction is low or absent, and remains so until the fatal end; in less severe cases the low values rise to normal with clinical improvement; and in mild cases there is only moderate depression of the ester values.

As a part of the investigations on liver function in infancy, determinations were made of the serum cholesterol and its partition in a group of infants suffering from hemolytic disease of the newborn. This article records the results and attempts to assess their significance. The subjects for investigation were 14 patients at the Children's Hospital, Birmingham, Alabama.

The changes in the cholesterol partition in 9 of the 14 cases of hemolytic disease of the newborn were quite similar to those demonstrated as characteristic of acute toxic injury of the liver. No explanation could be offered for the fact that in 5 cases in the series no such changes were found.

ERNEST E. ARNHEIM, M.D.

## MISCELLANEOUS

Power, H. A., and Cravotta, C. A.: Penicillin in Obstetrics. *Pennsylvania M. J.*, 1946, 49: 491.

This is a concluding report by the authors on penicillin used in 112 obstetric patients. The original report outlined the indications, contraindications, and limitations of sulfonamide therapy, and compared these factors with those involved in penicillin

therapy. The dosage used in the cases treated varied from 100,000 to 1,610,000 units.

The following is a list of the conditions which were treated with penicillin and the results obtained:

Acute mastitis—25 cases. Erythema and cellulitis diminished 50 per cent within 24 hours, and usually disappeared in 48 hours.

Cesarean section—26 cases. Thirteen were treated prophylactically and 13 for active infection. In the latter group the hospital stay was from 14 to 42 days.

Endometritis—20 cases. The prophylactic administration of penicillin following prolonged rupture of the membranes, for inertial labors, and to infected patients assured a smoother convalescence and shorter hospital stay.

Septic abortion—23 cases. Penicillin was found to be particularly effective in patients with a low hemoglobin as it had no influence on the red blood cells and hemoglobin levels.

Gonorrheal infection—5 cases. All of them were cured.

Postpartum cellulitis. No conclusions could be drawn from the results in these cases.

Omphalitis. This condition in the newborn responded quickly to penicillin.

The conclusions drawn in the first report of these investigators were confirmed by this larger additional series of cases. The absence of mortality and the decrease in length of hospital stay were most gratifying.

CATHERINE B. HESS, M.D.

Laqueur, W. A.: A Morphological Study on Chorionic Epithelial Proliferations Based on 10 Cases. *J. Obst. Gyn. Brit. Empire*, 1945, 52: 468.

The relationships between the development of the trophoblast and (1) the normal or penetrating placenta, (2) the simple hydatidiform mole, and (3) the chorioepithelioma are elucidated from histopathological studies of 10 cases. The modern concept of the trophoblast is that it produces the many cell types of the chorionic epithelium in successive stages of differentiation. The earliest stage consists of the Langhans cells which infiltrate like malignant tissue and the secondary formation consists of the syncytial cells which appear whenever the Langhans cells come in contact with liquid material. The function of these cells is to nourish the fetus by further proteolytic liquefaction of the maternal tissue. Syncytial cells also appear when local conditions become less suitable for cell nutrition, hence their appearance occasionally in nonliquefied tissues. The so-called pathological "syncytial giant cells" develop from the trophoblast but appear far from the placental site and can maintain themselves in the maternal tissues for a long period. Degeneration of chorionic epithelium produces the so-called fibrinoid coagulation which (1) forms a demarcation zone along the "stripe of Nitabuch" (a maternal barrier against the invading trophoblast), and (2) appears at sites of irregular proliferation of the chorionic epithelium either in the marginal vessels or in the myometrium.

The ovum imbeds itself when the trophoblast has developed the power to dissolve maternal tissues. Gradually the defense of the maternal tissues grows stronger, as the invasive power of the chorionic epithelium weakens, eventuating in the so-called "histiotrophic" phase of the trophoblastic development when the trophoblast nourishes itself at the cost exclusively of the maternal tissues. The trophoblast, its task fulfilled, disappears soon after the tenth week of pregnancy, leaving behind only the epithelium of the villi. The fetal stroma does not exist during the histiotrophic phase, but appears later when the villi first appear and is not vascularized; its development comprises the so-called cytotropic phase of growth which is found in the chorioepithelioma.

The pathological problem is to evaluate abnormal chorioepithelial proliferation, which upsets the balance between the destructive power of the cells of the young trophoblast and the maternal defense mechanism which comes into full action only slowly and progressively.

Four cases are presented which illustrate non-malignant chorionic invasion and the intimate reciprocal interference of maternal and fetal parts: 2 of abortion, 1 of myoma uteri, and 1 of spontaneous rupture of the uterus and persistence of the trophoblast. The presence of chorionic giant cells, noted in the pathological specimens of the 4 cases, is not necessarily indicative of malignancy unless the cells persist beyond the fourth week after abortion or delivery, and then only if they appear in large numbers. The presence of placental remains in the specimen also argues against malignancy. A fully developed decidua acts as a barrier against the abnormal proliferation of chorionic elements and especially of the giant cells. In pregnancy in an abnormal uterus, in endometriosis, or in the presence of a hydatidiform mole or placenta previa, these giant cells are seen in large numbers. In such cases, determinations of the gonadotropic hormones in the urine should be carried out, as well as close clinical check-ups, either to substantiate or rule out the presence of malignancy.

Three cases illustrating the increased proliferative power of the chorionic epithelium are presented, a case of spontaneous rupture of the uterus, and 2 cases of hydatidiform mole. In the first case enormous destruction was found in the presence of morphologically unaltered chorionic epithelium, and the muscle showed extensive necrosis, fibrinoid degeneration, and chorionic elements, singly and in masses, eroding and obstructing the vessels. The second case demonstrated a hydatidiform mole *in situ* penetrating deeply into the muscle, the penetrating cells consisting mainly of small Langhans cells and showing few degenerative changes; they massively infiltrated all of the layers, undermined the margins of the neighboring tissues, and infiltrated the venous sinuses. The third case demonstrated a hydatidiform mole showing excessive proliferation of the epithelium, with a preponderance of syncytial

cells and associated with typical puerperal changes; there was also a metastasis to the vulva. It is concluded that a diagnosis of malignancy (at best a difficult one to make on purely morphological grounds) should be based on (1) a preponderance of epithelial over stromal cells in the invading trophoblast, and (2) independent epithelial proliferation in at least one place (cytotrophic growth). The close association of epithelial elements, both syncytial and Langhans, with villous stroma argues against malignancy.

Three cases are described which showed chorionic proliferation without villous stroma, 2 of chorioepithelioma and a third of nonmalignancy in spite of chorionic elements found in the uterine curettings. In the first case microscopic examination of small nodules found in a surgically removed uterus and a small vulval nodule disclosed hemorrhagic necrosis, Langhans cells in large numbers, and no villous stroma. In the second case the uterus at autopsy showed extensive destruction of its tissue by large irregular masses of epithelial elements with extension into the vessels; the clinical history of this case was of postpartum hemorrhage. In the third case, curettings showed epithelial elements, syncytial cells, in

preponderance; the diagnosis of chorioepithelioma was refuted by the hysterectomy specimen which disclosed a normal uterus. The curettings were evidently only cells from a simple trophoblast.

It is concluded from these 10 cases that isolated chorionic cells per se are indicative only of a state of pregnancy, and that in large numbers they point merely to an abnormality of the uterus and not to increased independent activity of trophoblastic derivatives. The wide range, variations, and distribution of cell proliferation and infiltration makes the problem of deciding between malignancy or vigorously growing young trophoblasts a difficult problem for the pathologist, and necessitates careful correlation of these findings with the clinical history and hormone estimations. The presence of chorionic cell proliferations in (1) the last month of pregnancy, (2) after delivery, or (3) after expulsion or removal of a hydatidiform mole is generally indicative of malignancy; when they are seen early in pregnancy or in a still existing hydatidiform mole, the diagnosis of malignancy must be made with reservation. Finally, vaginal metastases are not necessarily malignant, and are benign when villous elements are also seen.

PHILIP B. CHASE, M.D.

# GENITOURINARY SURGERY

## ADRENAL, KIDNEY, AND URETER

Oddo, V. J.: Report of a Case of Acute Hemorrhagic Adrenitis. *J. Urol.*, Balt., 1946, 55:1.

Oddo reports a case of unilateral hemorrhage into the adrenal gland in which the patient recovered following surgical measures. The disease has been described under different terms, such as the Waterhouse-Friederichsen syndrome, spontaneous suprarenal hemorrhage, and suprarenal apoplexy.

The patient was a white female, aged 36, who entered the hospital complaining of pain in the left upper quadrant and abdominal cramps for the preceding 2 weeks. The pains radiated to the left posterior renal region, the left scapula, and the vesical region, and were accompanied by nausea, vomiting, and frequency of urination. A moderate anemia was present. The urine contained many leucocytes and a few erythrocytes. Intravenous pyelography showed that the left kidney was enlarged and displaced downward; an abnormal soft tissue mass occupied the left upper posterior abdominal quadrant; the stomach was displaced to the right by an extrinsic mass in the same quadrant. Examination of the chest demonstrated the left diaphragm to be partially obliterated and elevated. It was smooth and regular. There was no evidence of metastatic disease in the lungs. Retrograde pyelography verified the previous findings. The temperature was septic in character. The patient suffered greatly from nausea, dyspnea, and pain, and as a result was losing weight rapidly.

Five weeks after admission laparotomy demonstrated a very large mass, smooth and tense, which had been palpable in the left upper quadrant of the abdomen. It extended upward as far as the tenth rib and downward to the crest of the ilium. The kidney could not be differentiated and appeared to be part of the tumor mass. Because of the position, immovability, and inaccessibility of the mass it was deemed better not to attempt its removal or even obtain a biopsy. The right kidney was palpable and not enlarged. The abdomen was closed and the patient left the hospital.

She was readmitted 18 days later, having lost 16 pounds and in much poorer condition. At the insistence of the patient a second operation was performed. The kidney could not be delineated. The tumor was tense, smooth, and appeared solid. After the perirenal fascia was opened, it was found that the kidney was situated below the tumor mass and was uninvolved. An incision was made into the mass for biopsy and more than a quart of dark liquid blood was obtained. After removal of a triangular section of the wall two cigaret drains were inserted into the tumor cavity, and the wound was closed.

The pathologist stated: "The specimen consists of an organized blood clot, connective tissue, and fat.

Some sections of the connective tissue element show cortical adrenal cells with deep staining nuclei and pale cells with granular protoplasm. The tissue was markedly infiltrated with leucocytes. Numerous thin walled blood vessels and nerve fibers were present."

Immediately following the operation the dyspnea quickly subsided, and the patient made an uneventful recovery.

DAVID ROSENBLUM, M.D.

Russi, S., Blumenthal, H. T., and Gray, S. H.: Small Adenomas of the Adrenal Cortex in Hypertension and Diabetes. *Arch. Int. M.*, 1945, 76: 284.

The authors have undertaken a study to determine whether or not small adrenocortical adenomas, encountered incidentally in the course of routine autopsies in persons showing no apparent evidence of endocrine dysfunction during life, could be implicated, in retrospect, in certain hormonal disturbances. In the course of 9,000 consecutive autopsies, 131 cases, an incidence of 1.45 per cent, exhibited these cortical adenomas. The incidence in males and females was approximately equal. The majority of adenomas occurred in persons more than 40 years of age, a peak occurring in the decade between 60 and 69 years. This, in general, corresponds with the age distribution in autopsies and may be significant.

The cortical cells of which the adenomas were comprised were of two types: (1) the predominant type, with a centrally or eccentrically placed hyperchromatic nucleus and cytoplasm filled with lipid vacuoles, and (2) a type with a centrally located nucleus, more vesicular than that seen in the first type, and cytoplasm either homogeneously eosinophilic or containing finely dispersed lipid droplets.

Analysis of the clinical data indicated that hypertension and diabetes were the only clinical conditions occurring with sufficient frequency in association with these small cortical adenomas to be warranted significant. Three levels of criteria for the determination of the existence of hypertension were used. On the basis of clinical data, the less critical criterion of blood pressure (140 systolic and 90 diastolic) indicated that there was an incidence of 70 per cent in the group with adenomas, as compared with 54.9 per cent in a general clinical group. The higher criterion of diastolic pressure in excess of 95 showed an incidence of 42 per cent, as compared with 22.4 per cent in the clinical group. The still more severe criterion, based on necropsy evidence of cardiac hypertrophy in the absence of contributory valvular or myocardial lesions, showed that 72.9 per cent of persons in the cortical adenoma group were hypertensive, as compared with 13.9 per cent in the general group examined at autopsy.

Among the 131 persons who exhibited cortical adenomas at autopsy, there were 21 with proved

diabetes, an incidence of 16 per cent. This is significantly higher than the 3 per cent incidence of diabetes in the entire autopsy group.

In the discussion of the apparent relation between cortical adenomas and hypertension, two possibilities, supported by experimental observations, are cited: (1) the adrenal hormones may render a person more sensitive to renin, or (2) they may be instrumental in producing changes in the kidneys which would lead to an increased renin production. It is generally agreed that certain adrenal cortical hormones increase the rate of glyconeogenesis and by this means increase the blood sugar level. The authors postulate that the increased incidence of diabetes in association with cortical adenomas derives from an increased production of cortical hormones.

In the discussion of the physiological roles of the two types of cells noted in the histological sections, the hypothesis is advanced that the vacuolated cells may well contain stored adrenal hormones, while the more solid cells are those in which the hormones are being discharged as rapidly as they are formed.

CLARENCE V. HODGES, M.D.

Duff, J., Kenyon, H. R., and Smith, K. F.: Malignant Hypertension; Neurosurgery of the Kidney. *J. Urol.*, Balt., 1946, 55: 153.

Establishment of the diagnosis of nephralgia is fraught with difficulty and a degree of uncertainty, but as an entity it certainly does obtain. The condition is characterized by intractable pain of kidney origin without demonstrable renal or ureteral pathological changes. It is, therefore, vital to exclude intrinsic kidney, pelvic, or ureteral disease. The most helpful differentially diagnostic sign, an observation emphasized by D. K. Rose, is the reproduction of the pain previously complained of by intentional distention of the renal pelvis. Pain thus elicited should reproduce precisely in location and radiation the patient's original complaint.

The operative technique for relief of nephralgia requires identification of the sympathetic nerve fibers and renal ganglion on the posterior and lateral aspects of the renal artery. They can be easily elevated with forceps and severed with scissors.

The renal artery is also denervated when judiciously possible, in conjunction with nephropexy, pyeloplasty, and nephrectomy.

The experimental and clinical researches of the past few years have focused our interest in the problem of hypertension. Whereas formerly the urologic surgeon was primarily concerned with controlling the effects of high blood pressure and its complications in patients under treatment for obvious urinary or genital disorders, we have, of late, approached the greater problem of underlying, causative factors in the development of hypertension, especially in relation to the kidneys, their blood supply, and neurological dysfunctions.

Of such patients coming under urologic supervision, four main categories can be defined: (1) those

with known urinary tract disease and concomitant hypertension; (2) hypertensive patients with asymptomatic disease of the urinary organs; (3) a miscellaneous group presenting endocrine lesions associated with elevation of the blood pressure; and (4) essential hypertensives.

All cases of hypertension are by no means malignant. Many are relieved and the individuals live comfortably for years under medical and physiotherapeutic regimes. Malignant hypertension is as yet a disease of unknown origin.

However, if the kidney is not the site of origin in malignant hypertension, at any rate it is the vital center of symptomatic projection; but further research may show the kidney to be the "victim rather than the culprit."

Malignant or essential hypertension at present can be most successfully relieved by surgery. Estimation of renal function and evaluation of the structural integrity of the kidneys are among the more important preoperative diagnostic procedures, and as the surgical approach is retroperitoneal, the operation should include exploration of the adrenal gland and biopsy of the kidney. It is, therefore, evident that the urologic surgeon possesses fundamental advantages in this field of surgery. The selection of cases and decision for operation requires thorough examination and classification.

Co-operation of competent consultants in the various specialties concerned is of utmost importance. Complete data regarding (a) eye grounds, (b) kidney function, and (c) electrocardiographic studies are essential to the diagnosis and prognosis.

In contradistinction to peripheral vascular diseases, the degree and severity of hypertension in essential hypertensives cannot be accurately determined preoperatively by nerve block.

Excretory urography is of value not only as an indicator of kidney function, but may be indicative of renal blood flow. It was observed that the dye should normally be excreted in about 55 minutes. If a roentgenographic shadow is demonstrable in the kidney pelvis after an hour, without obstructive uropathy, it can be assumed that the renal blood flow is impaired, provided that nephritis and nephrosis have been excluded.

Retrograde pyelographic studies, if not contraindicated, and kidney function tests, should precede all operations for malignant hypertension.

It is interesting to note that, following successful thoracolumbar sympathectomy, a most unpromising preoperative T-wave electrocardiogram report may be completely reversed.

The operation is bilateral and is performed in two stages, right and left. The first, second, and possibly the third lumbar ganglia, the ganglionic chain from the seventh to and including the twelfth thoracic ganglion, the greater, lesser, and least splanchnic nerves on each side are identified, dissected, and removed.

Observations by the authors and others working in this field indicate that following the Smithwick

sympathectomy abnormal renal blood pressures and ocular and cardiac findings present before operation show marked improvement. JOHN A. LOEF, M.D.

**Dodson, A. I.: Some Improvements in the Technique of Ureterocystostomy.** *J. Urol., Balt.*, 1946, 55: 225.

The urologist's experience with ureterocystostomy has, in the past, been confined usually to the reimplantation of the ureter, following its excision in cases of carcinoma of the bladder or in disease of the distal end of the ureter. The treatment of injuries resulting from pelvic surgery has in most cases been done by the surgeon or gynecologist responsible for the injury. However, in recent years the urologist has been called on more frequently to assist in the treatment of these patients.

The technique of the operation used will vary according to the problems met and, to some extent, according to the preference of the surgeon. The ureter can be transplanted successfully either transperitoneally or retroperitoneally. In the transperitoneal operation the peritoneum should be ac-

curately sutured over the ureter and extraperitoneal drainage should be provided to the area of implantation. Transperitoneal implantation is the natural procedure when an injury of the ureter is discovered at the time of a pelvic operation. When the operation is done only to reimplant the ureter into the bladder, the extraperitoneal approach has several advantages. The ureter is more easily exposed and liberated. Both the ureter and the portion of the bladder presenting the most desirable location for reimplantation are normally extraperitoneal. Retroperitoneal drainage is more easily instituted and there is less danger of disastrous results from leakage or infection.

Several writers have called attention to the value of mobilizing the bladder to decrease the tension at the point of union, and Kelly advised suturing the mobilized bladder to the pelvic wall to prevent tugging on the line of sutures by muscular contraction.

No one has, to the author's knowledge, mentioned the advantage of mobilizing or straightening the ureter to lengthen it and so lessen the distance that

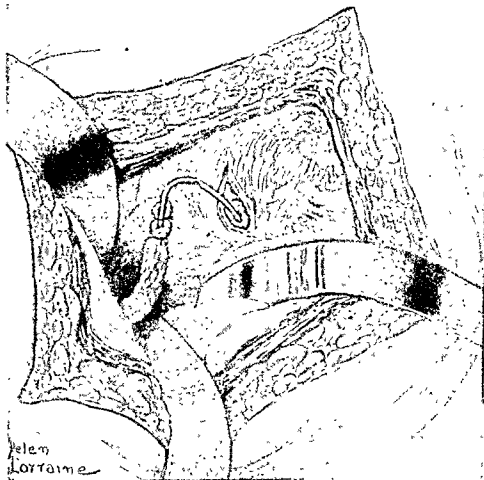


Fig. 1. The incision has been made in the bladder wall, exposing the mucosa which is incised at the lower angle of the wound. A small catheter tied in the beveled ureter and sutured to the end of a catheter drawn from the bladder is being pulled out through the urethra. Ligation around the upper ureter interferes with drainage around the catheter and should be omitted.



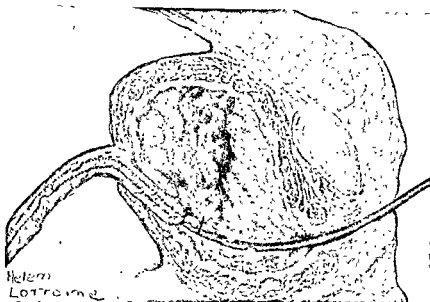


Fig. 2. The ureteral catheter, having been pulled through the urethra, serves as a splint to the ureter and for drainage from the ureter and bladder

it must traverse to reach the bladder. The additional length of ureter made available by this procedure is considerable. This is true particularly when the ureter has become dilated and tortuous because of partial obstruction which often occurs following disease or fistula at the lower end of the ureter. Too, the ureter describes a considerable arc as it curves outward and backward along the surface of the true pelvis. This arc can be straightened to a considerable extent without interference with the physiology of the ureter. The abundant blood supply and the free anastomosis of the ureteral blood vessels make it possible to free the ureter almost completely without danger of necrosis. The ureter is only endangered when the loose fibrous coat is stripped

away. The author has found it necessary to ligate a small bleeding vessel at the end of the ureter before transplanting it when the ureter has been completely liberated well above the brim of the true pelvis.

The following is a description of the operation which, in the hands of the author, has given the most satisfactory results:

An incision is made, beginning just above and about 2 inches medial to the anterior spine of the ilium, and extending downward and inward parallel to Poupart's ligament. It ends in the midline of the abdomen, just above the pubis. The aponeurosis of the external oblique muscle is split throughout the length of the incision. The internal oblique and transversalis muscles are divided in the direction of



Fig. 3. Left, Mattress sutures fix the ureter in place; right, the muscles and fibrous coat of the bladder are closed over the ureter.

their fibers near the margin of the rectus muscle, just below the level of the anterior superior spine of the ilium. The fused aponeurosis of these muscles is then cut just external to the margin of the rectus down to the pubis. This gives room for wide exposure of the retroperitoneal area. The peritoneum is then separated from the posterior abdominal wall by blunt dissection from above the brim of the pelvis down to the bladder and medially to the spine. As the peritoneum is retracted medially, the iliac vessels are exposed and the ureter can be seen as it passes over these vessels and can be traced along the posterior surface of the peritoneum until it enters the bladder or disappears into a mass of adhesions surrounding a ureteral fistula. The ureter is freed from the peritoneum, from well above the iliac vessels downward to the fistula, or in ureteral disease, to the bladder. In the female, if the ovarian vessels interfere with liberation and exposure of the lower end of the ureter, they may be ligated and divided. The ureter is then divided just above the fistula or the diseased area. The lower segment is ligated or excised according to indications.

An incision is then made in the posterior wall of the bladder, extending from above downward, about an inch long, and as near the original ureteral entrance as possible. The incision extends to, but not through, the mucosa, which is carefully dissected from the bladder muscles for a short distance on both sides of the incision. The mucous membrane of the bladder is then incised at the lower end of the incision, and the end of a catheter, previously passed through the urethra, is grasped and pulled through the incision. The end of the ureter is beveled and a small, soft rubber catheter, which has had its end cut off and 2 small holes made in its sides near the end, is inserted into the ureter for 3 or 4 inches. A suture of plain catgut is passed through the tip of the beveled ureter and tied snugly to the catheter (Fig. 1). The catheter should not completely fill the lumen of the ureter. Two more holes are made in the catheter about an inch below the end of the ureter. The distal end of this catheter is then sutured to the tip of the bladder catheter, which is withdrawn, and the end of the catheter in the ureter is pulled out through the urethra (Fig. 2).

Fixation sutures are taken through the superficial tissues of the ureter on each side about an inch from the beveled tip. Both ends of these sutures are threaded on a small curved needle. The point of the needle is passed through the incision and the bladder wall from within outward. As traction is made on the catheter, the ureter is pulled into the bladder until the area pierced by the sutures enters the bladder incision. The sutures are drawn taut and tied on the outside of the bladder as mattress sutures (Fig. 3). The muscle and fascia of the bladder are fastened over the ureter from below upward with a continuous suture of chromic catgut (Fig. 4). The last suture should catch a small piece of the superficial tissue of the ureter. A small rubber tissue drain is carried down to the implantation and

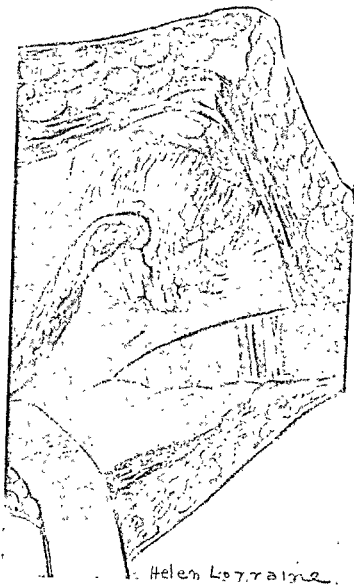


Fig. 4 Completed implantation.

brought out near the upper angle of the wound. A mushroom catheter is then inserted into the anterior bladder wall through a short incision and a purse string suture is placed around the catheter, to make a water tight closure. The catheter is brought out at the lower angle of the wound. With the small catheter in the urethra and the large catheter placed suprapubically, complete drainage and absolute immobilization are assured. When the length of the ureter does not permit a submucous implantation, the operation differs only in that the ureter enters the bladder through a short incision directly through the bladder wall.

In addition to a summary of the viewpoints of numerous urologists on the techniques in vogue for the performance of ureterocystostomy, the article also includes 2 case histories illustrating the indications for surgical intervention and the results obtained from this operation.

EUGENE J. AUDI, M.D.

## BLADDER, URETHRA, AND PENIS

Mahoney, J. F., Blum, H. L., Van Slyke, C. J., and Cutler, J. C.: Experimental Gonococcal Urethritis in Human Volunteers. *Am J Syph*, 1946, 30, 1.

The authors report a study in the prophylaxis of gonorrhea employing human volunteers in a federal penitentiary. The study was terminated when it became evident that the principal objective probably could not be attained through the approach which was employed. Effort was made to develop a technique for disease production in volunteers which would be successful in the large majority of exposures. Two hundred and forty-one volunteers were employed. Each was given a financial reward and a certificate of participation. The ages ranged from 21 to 45 years. There was no evidence of pre-existing gonococcal infection; the urine sediment was negative on culture on three occasions (once after prostatic massage) prior to commencement of the study. There was no genital anatomical abnormality nor history of arthritis, but assurance of 6 months of postexposure observation availability. The volunteers were free of intercurrent disease or debility. They understood the purposes of the study, the risks involved, and were mentally acceptable.

Various infecting techniques were employed consisting in general of the instillation of 0.1 ml. or more of a suspension of gonococci into the navicular fossa, and, in certain instances massage, stretching, and engorgement of the glans and shaft of the penis. The technique was altered and varied as the experiment went on. None of the adaptations of the infecting technique employed was capable of producing disease in the uniform manner required to establish a prophylactic method. The general pattern of infections produced seemed to indicate that the constitutional resistance inherent in the individual volunteer is the factor which determines that an exposure technique, although successful in some members of the experimental group, may fail in others. The only exception occurred when direct transmission of the secretions from an infected patient to the urethra of a normal volunteer was done. Several instances of prolonged incubation were recorded.

In many patients, burning on urination occurred within the first 48 hours after inoculation. In some, a secondary urethral response, consisting of a culturally negative urethral discharge which occurred even weeks or months after inoculation, was observed. Commonly pain and tenderness of the vas deferens and/or epididymis, unilateral, bilateral, or alternating from side to side, was encountered. The authors termed this "vasosis" and "epididymosis." They believe that there was a spread of an irritant factor from the meatus to and through the vas deferens which caused vasosis and epididymosis. The presence of complement fixing antibodies seemed to indicate a minor degree of resistance to-

ward experimental infection. There was no instance of a persistent carrier state.

Sulfathiazole was administered for treatment and penicillin was given to sulfonamide resistant cases.

DAVID ROSENBLUM, M.D.

## GENITAL ORGANS

Kennaway, E. L., and Kennaway, N. M.: The Social Distribution of Cancer of the Scrotum and Cancer of the Penis. *Cancer Res*, 1946, 6, 49.

The authors tabulated 921 cases of cancer of the scrotum or of the penis according to the occupation of the patients, and came to the following conclusions:

The ratio of cancer of the scrotum to cancer of the penis is 1 to 20 in the agricultural workers, who are mostly agricultural laborers, and is nearly 3 times greater, or 1 to 2.6, in the nonagricultural laborers. Those engaged in lighter manual labor have a lower proportion of scrotal cancer than those performing the heaviest work. The clerical and light manual workers have a low ratio of scrotal cancer.

One case only of cancer of the scrotum occurred in England and Wales during a period of 30 years, in 17 occupations of the highest professional class. This 1 case was that of a person who in earlier life had belonged to a lower social class. The number of cases to be expected among the same number of persons, not especially exposed to carcinogenic materials, in the general population would be about 21. Hence it appears that this form of cancer could be eliminated by social factors. As cancer of the penis does not show this social distribution, these two types should not be pooled for statistical purposes. Data on the occurrence of cancer of the scrotum in native races and nonindustrial populations would be of great interest.

These two forms of cancer can be wholly eliminated: that of the penis by circumcision in infancy (but not in later life, according to the Moslem practice), and that of the scrotum through the conditions of life attainable by the richest classes.

JOSEPH K. NARAT, M.D.

## MISCELLANEOUS

Prather, G. C.: War Injuries of the Urinary Tract. *J. Urol.*, Balt., 1946, 55: 94.

Ten cases of injury of the urinary tract were observed in the Ashford General Hospital, in the Zone of the Interior, and the late results are described.

In 2 patients with penetrating wounds of the kidney and associated intra-abdominal wounds, transperitoneal nephrectomy had been performed at forward hospitals. In 2 of 3 cases of ureteral injury, also with intra-abdominal involvement, late nephrectomy was necessary—in 1 patient for persistent fistula and in the other for calculous pyonephrosis. Two patients with rupture of the urinary bladder, and 1 patient with late perforation of the urinary bladder from a shell fragment, were treated by

suprapubic cystostomy. In 1 patient with multiple wounds of the thigh, scrotum, and leg, transection of the penile urethra was done. In this case there was also fracture of the right fibula and injury of the sciatic nerve. The urethra was successfully repaired 5 months after injury. In 1 patient with severe injury of the glans penis and distal urethra, fibrous atresia had developed and this was repaired by a plastic procedure.

The author states that although all of the definitive surgery and a good part of the reparative surgery in cases of this type has been completed before they reach the Zone of Interior, the facilities of rear echelons may sometimes be required for a detailed estimate of their final status. A named general hospital receives patients with injuries of this type for evaluation, further convalescence, and disposition.

FREDERICK R. LIEBERTHAL, M.D.

**Kimbrough, J. C.: War Wounds of the Urogenital Tract. *J. Urol.*, Balt., 1946, 55: 179.**

In the examination of 147 bodies of members of air crews killed in action, 9.5 per cent were found to have injuries of the genitourinary system in addition to other fatal wounds.

In the general hospitals on the continent, 235 consecutive wounds of the genitourinary system were treated from June to October of 1944. The kidney was involved in 14 per cent, the ureter in 3.4 per cent, the bladder in 14.5 per cent, and the external genitalia in 68.1 per cent of the patients.

**Wounds of the kidney.** In many cases the multiplicity of severe wounds makes complete urological examination impracticable. The urine of all patients with abdominal wounds should be examined. The presence of blood indicates injury to the genitourinary tract. Excretory urography may be used in field and evacuation hospitals, but its value is easily overrated. The function of damaged kidneys is usually suspended for several hours after injury, and the renal x-ray outline will not be present even in mild injury. Cystoscopy and retrograde urography are of doubtful value in field and evacuation hospitals because of the time required, and the trauma incident to instrumentation.

Thirty-three wounds of the kidney (14%) were observed. In 70 per cent, the only operative treatment required was that of the associated wounds. Nephrectomy was necessary in 24 per cent.

**Wounds of the ureter.** The diagnosis is often made at operation by the presence of urine in the wound. Urography, excretory and retrograde, is rarely practicable at the time of initial surgery. The low incidence of ureteral wounds reported is probably due to the fact that death from associated severe injuries usually occurs before the patients reach hospital facilities. Ureteral injuries should be repaired at the time of initial surgery. The ureter is sutured over a ureteral catheter which is left in place, and the urinary stream above the site of the injury is diverted. Massive scar tissue usually prevents ureteral repair at late operations.

**Wounds of the bladder.** The diagnosis is often made by a general physical examination and evaluation of associated wounds. Early diagnosis is imperative in avoiding a high mortality. Diagnostic urethral catheterization is very helpful. Digital rectal examination with the urethral catheter in place is a valuable procedure. Cystoscopy and the cystogram with air or opaque medium are usually not necessary in field and evacuation hospitals. If sufficient information is not obtained with these measures, exploratory operation is preferable to delay in cases of doubt. Further waste of time in determining if the wound is extraperitoneal or intraperitoneal should also be avoided because this can be ascertained at operation. Early drainage by cystostomy is necessary. Catheter drainage alone is rarely satisfactory and is usually dangerous. Repair of the injury is desirable. The recognition and treatment of associated wounds of the bowel and ureter are essential. The bladder is rarely involved alone.

**Wounds of the external genitalia.** In 160 patients with wounds of the external genitalia, the urethra was involved in 34, the penis in 44, and the scrotum and testicles in 82. In urethral injuries, repair should be carried out as soon as practicable. The urgencies of combat may often limit early treatment to control of hemorrhage and the conservation of tissue. Later repair is complicated by scar tissue formation and the resulting deformity. In treating wounds of the scrotum and testis, control of hemorrhage and conservation of tissue are imperative. All testicular tissue must be saved. The only indication for the removal of the testis is complete destruction of the blood supply.

**Neurogenic bladder.** Neurogenic bladder results from injury to the brain, spinal cord, or the peripheral nerves supplying the bladder. The majority of cases are due to spinal cord lesions. The injury due to edema, hemorrhage, and other types of compression is usually mild, and the urinary retention is transient. Injuries to the brain are often followed by no more than transitory retention of from 2 to 3 days' duration. Lesions of the cervical cord and upper dorsal cord offer a fair prognosis for establishing the so-called automatic bladder. Bladder dysfunction due to lesions of the lower dorsal and lumbar cord is more serious. Those due to involvement of the sacral cord are the most serious, and the patients rarely recover. As soon as the presence of a neurogenic bladder is determined, an inlying urethral catheter is inserted and tidal or other drainage is instituted. If the bladder does not show evidence of recovery in 4 weeks, a suprapubic cystostomy is performed, provided the patient's condition offers a reasonable life expectancy. The bladder should never be permitted to become overdistended. Spontaneous overflow, manual expression, and intermittent catheterization should be avoided strenuously. The catheter should not be left in place in the presence of severe infection. Early evidence of return of function, before any clinical signs of recovery

are evident, can be ascertained with the cystometer. Simple apparatus such as the water manometer is preferable. In the 193 cases reported by the author the bladder function did not return in 134. Cystostomy was performed in 130 of these. Catheter drainage, tidal and otherwise, was employed in 63 cases. Suprapubic cystostomy properly performed is the best standard procedure for general use by army surgeons. **FREDERICK R. LIEBERTHAL, M.D.**

**Freid, J. R.: Skeletal and Pulmonary Metastases from Cancer of the Kidney, Prostate, and Bladder.** *Am. J. Roentg.*, 1946, 55: 133.

The relative incidence of skeletal and pulmonary metastases from cancer of the urinary tract has been studied by the author in a series of cases coming to autopsy. The statistics obtained are compared with those cited in the literature dealing with this subject.

Of 87 cases of carcinoma of the kidney, 39 (45 per cent) showed skeletal metastases on roentgen or postmortem examination. The axial and trunk bones were more frequently involved than were the bones of the limbs. The lesions, multiple or single, were always destructive in character and rarely produced new bone.

Of 60 cases of carcinoma of the prostate, 35 (58 per cent) exhibited skeletal metastases. These lesions were essentially osteoplastic in character, but small areas of bone destruction were also generally present. In only 3 instances were purely osteoclastic changes observed.

Of 56 cases of carcinoma of the bladder, 6 (10 per cent) had spread to the skeleton, but in only 1 case were true metastases observed, the others repre-

sented invasion by direct extension from the primary tumor. In the cases of metastases cited in the literature, involvement was practically always osteoclastic.

Observations on irradiation therapy of bone metastases from carcinoma of the prostate and kidney indicate that little if any healing takes place following therapy and that the object of such treatment must be entirely that of palliation.

Of 87 cases of carcinoma of the kidney, 47 (54 per cent) showed pulmonary or pleural metastases. Parenchymal lesions were the most frequent and usually consisted of fairly large, sharply outlined nodules, most numerous in the lower two-thirds of the lungs. When pleural involvement was present, there was also usually an associated pleural effusion.

Of 60 cases of carcinoma of the prostate, 26 (43 per cent) presented intrathoracic extension of the disease. The most frequent finding was the association of pleural and pulmonary metastases.

Of 56 cases of carcinoma of the bladder, 4 (7 per cent) presented intrathoracic involvement.

Cough and dyspnea were the complaints most frequently complained of when pulmonary spread has occurred. Pain was next in frequency, and hemoptysis was rare. Irradiation was often ineffectual as a mode of therapy, usually because the patients were in such poor general condition that they could not tolerate the large dosages of radiation necessary for the relief of symptoms. Occasionally, however, relief of the cough and dyspnea and, when pleural effusions were present, slower refilling of the chest followed such treatment.

**CLARENCE V. HODGES, M.D.**

# SURGERY OF THE BONES, JOINTS, MUSCLES, TENDONS

## CONDITIONS OF THE BONES, JOINTS, MUSCLES, TENDONS, ETC.

Greengard, J.: *Acute Hematogenous Osteomyelitis in Infancy. Med. Clin. N. America*, 1946, 30: 135.

Acute osteomyelitis in infancy has certain characteristics which are different from those seen in the older child and adult. In infancy, acute osteomyelitis is essentially a septicemia with localization in the bone, and in its management the blood stream infection and the primary portal of entry merit prime consideration. In infants as well as in older children, the infection in the bone starts in the metaphysis, but in infants there is a minimal amount of cortical bone at the metaphysis, so that spread to subperiosteal space is direct. The periosteum, more loosely attached at this age, is dissected from the cortical bone and the resultant subperiosteal abscess may rupture into the soft tissues without necrosis of the shaft.

The symptoms of acute hematogenous osteomyelitis in early infancy are variable. Two forms of the disease have been recognized in the newborn—one benign, the other severe. In the benign form there is usually no history of a preceding illness, and an area of swelling and dysfunction is noted over one of the long bones. On x-ray examination, an osteomyelitis is found which after several weeks or months undergoes resolution, without chronic disability as a rule. In the severe form the onset is usually early in the newborn period, with marked fever, often of a septic type. The concomitant symptoms will depend upon the primary disease which constitutes the portal of entry of the blood stream infection. In the newborn the umbilicus is a common site and evidences of omphalitis may be present with redness, induration, and a purulent discharge. Occasionally, a thrombophlebitis of the umbilical vessels may be present without external manifestations. The respiratory tract may not uncommonly be the source of septicemia in the newborn. Suppurative complications of an upper respiratory tract infection, such as an otitis media or sinusitis, may be present, or a definite pneumonia may be found. The skin or, less commonly perhaps, the urinary tract may be the site of a pyogenic infection which may result in septicemia. The bacteriology of these cases is quite variable: streptococci (nonhemolytic), staphylococci, pneumococci, or the pyogenic organisms may be found in the blood stream. The infection is severe, is often associated with icterus and hemorrhagic manifestations, and the mortality, even with modern therapy, is high. Localization in the bone occurs relatively late in the course of the illness and may be discovered in the course of routine x-ray examination, or may manifest itself by the formation of local soft tissue abscesses. The focus may be single, or multiple

areas may develop, and the bone lesion is more apt to become chronic with the development of sequestra and sinus formation, and, when large segments of bone are destroyed, as in the case of the head of a long bone, may result in chronic disability. However, the degree of restoration of the involved bone to normal is often surprising.

In the older infant the early symptomatology is also dominated by the septicemic symptoms. There is usually a sudden onset, often with high fever, and not uncommonly with respiratory tract symptoms. In a few instances a history of trauma to the area later involved is elicited. An infectious diarrhea or furunculosis of the skin may be the initiating symptom. After a few days the infant begins to show evidence of disability of an extremity, there is frequent crying, and soon it is noted that an extremity is held quietly in a position of rest. Passive motion of the extremity is painful, and at times tenderness over a metaphysis may be demonstrated. Careful examination of the adjacent joints reveals their free mobility. An enlargement of the metaphysis develops, and later a sense of deep fluctuation may be felt in this region. Usually, a soft tissue abscess develops and approaches the surface. In the acute stage, the infant is severely ill, and blood cultures usually contain organisms. X-ray evidence of bone destruction may be found in from 7 to 10 days after the onset. When localization in the soft tissue has become well developed, usually 2 or 3 weeks after the onset, the toxic manifestations tend to subside. If recovery from the acute septic phase occurs the prognosis is good. The bone lesion seldom becomes chronic and complete restoration to normal is the rule.

The treatment of acute hematogenous osteomyelitis in infancy may be divided into medical and surgical therapy. Medical therapy is concerned essentially with supportive measures to combat dehydration and toxemia, and specific chemotherapy aimed at destroying the invading organism. Surgical therapy is concerned with the management of the local bone involvement. Dehydration must be combated by the administration of parenteral fluid and blood, usually given by the intravenous route.

Penicillin is very effective against most of the organisms in acute hematogenous osteomyelitis, and it may be administered in a single large intravenous dose, followed by divided intramuscular doses at three hour intervals throughout the septic period. The individual dosage will depend upon the severity of the infection, 30,000 to 50,000 units being administered as an initial dose, and 5,000 to 20,000 units intramuscularly every 3 hours thereafter.

The sulfonamide drugs may be used either alone or in combination with penicillin. Sulfathiazole or sulfadiazine will be found to be the most effective and best tolerated. They must be used in large doses

and the usual precautions must be followed regarding their toxic effects. The author has found it advantageous to alternate the drugs in individual cases. As a general rule, from 0.1 to 0.2 gm. (1.5 to 3 gr.) per pound of body weight per day may be administered. When vomiting occurs, or the infant is very toxic, the sodium salt may be given intravenously. Most infants tolerate long continued chemotherapy very well.

Local therapy of the bone lesion consists in immobilization, local hot wet dressings, and the incision and drainage of soft tissue abscesses when they appear. Surgery to the bone should be held to an absolute minimum; incision of the periosteum over a subperiosteal abscess should usually constitute the maximum handling permissible. Local use of penicillin or sulfonamides may be of aid after incision.

The author reports a group of 10 cases of acute osteomyelitis in infants under 2 years of age, observed in the Children's Division at the Cook County Hospital, Chicago. This small series differs in some respects from the usual experience in osteomyelitis in young children. Eight of the infants were girls, while most reported series reveal a predominance among boys. The age of the infants varied from 2 weeks to 22 months.

The primary illness differed widely. Five of the 10 infants had some sort of involvement of the respiratory tract prior to the onset of the osteomyelitis.

Organisms were recovered from the blood in 6 cases, while in 4, blood cultures were negative. A staphylococcus albus was isolated in 4 cases, and in the remaining 2 cases staphylococcus aureus was found. In the experience of Green and Shannon, the streptococcus was more commonly found in infants.

The bones involved were a rib in 3 cases, the humerus in 3, the tibia in 2, and the femur in 1 case. There was multiple bone involvement (scapula, rib, and phalanx) in a newborn infant. Eight infants are progressing to complete healing of the bones involved. The sequelae in the other 2 infants were chronic osteomyelitis of the scapula and destruction of the humeral head, respectively.

Soft tissue abscesses were drained in 3 infants. Six infants were treated with sulfonamide drugs in varying amounts, from 6 gm. to 385 gm. Penicillin was used in 3 infants, the dosage varying from 560,000 units to 4,200,000 units.

There were no deaths in this series.

ERNEST E. ARNHEIM, M.D.

Hertzberg, J.: On Osteoarthritis Alkaptonuria (Ochronosis), with Description of a Case. *Acta radiol.*, Stockh., 1945, 26: 484.

Alkaptonuria with ochronosis is of clinical significance mainly because it occasionally produces joint lesions. They are caused by the deposition of ochronotic pigment in the joint cartilages, which become abnormally brittle and give rise to a specific kind of osteochondritis dissecans with loose body formation and synovitis (chondrosis dissecans

ochronotica). The gross roentgenological appearance of the joint lesions resembles that of deforming arthrosis.

The case of a 54 year old fisherman who complained of stiffness and pain in both shoulders for 2 years is presented. Alkaptonuria was discovered on admission. The principal roentgen findings were:

1. Osteoarthritis of both shoulders of a degree not seen in ordinary degenerative arthritis of the shoulders, characterized by large osteophytes, narrowing of the cartilage spaces, and rarefactions in the adjacent parts of the humeri.

2. Loose bodies, unusual width of the cartilage space between the femur and tibia, reduced width of the patellofemoral space, and subchondral sclerosis of the patella with osteophyte formation in both knees.

3. Osteoporosis and scoliosis of the spine with "pachy condensation" of the intervertebral discs.

A loose body was removed from the right knee together with a piece of the synovialis, to which it was adherent. The microscopic examination showed pigment in the bone spicules as well as in the surrounding connective tissues.

GERHART S. SCHWARTZ, M.D.

Bonnet, W. L., and Baker, D. R.: The Diagnosis of Pes Planus with X-Rays. *Radiology*, 1946, 45: 36.

According to Hfield, one-third of the men appearing before the C.D.D. Board of the Station Hospital at Camp Callan, California, came because of foot complaints.

In view of this very high incidence of foot disorders, the authors decided to carry out a systematic study on the possible roentgen diagnosis of pes planus and pronation of the foot.

In each instance a history of the case was taken first. Attention was paid to the various etiological factors such as heredity, especially through the paternal parent, static defects, infections, occupation, obesity, posture, and trauma.

The mechanism of pes planus is best understood by analyzing the effect of stress on the anatomic structures of the foot. Normally, the foot may be considered as an arch resting on two pillars. The anterior pillar corresponds to the heads of the metatarsals, the posterior pillar is represented by the os calcis, and the astragalus forms the keystone of the arch. Actually, there are two arches which meet in the subastragaloid articulation—the inner arch which serves the dynamic demand and the outer arch which controls side swaying movements. The axis of the joints of the foot are (1) the ankle joint, (2) the subastragaloid articulation, and (3) the 3 axes of the metatarsal joint. The principal joints involved in pes planus are the subastragaloid and midtarsal articulations. The deforming force consists of the rotatory component of upper pressure applied to the center of the ball of the foot. This results in rotation of the astragalus downward and inward, which causes flattening of the arch and convexity of the inner border, while the toes and meta-



Fig. 1. Roentgen measurement of the arch during repose.



Fig. 2. Roentgenogram of feet during weight bearing, double exposure technique.

tarsals rotate upward and outward. Thus the forefoot is in relative supination and dorsification as compared to the back part of the foot.

Pronation of the foot is, according to Morton, present when the body weight is concentrated upon the head of the second rather than of the first metatarsal. The criteria for diagnosis are: (1) elongation of the second metatarsal as compared with the first, (2) broadening of the shaft of the second metatarsal as compared with the fourth, (3) increased separation between the internal and middle cuneiforms, and (4) location of the sesamoids over the first metatarsal proximal to the head.

Flat feet and pronated feet may occur individually or they may coexist.

The roentgen technique devised by the authors is aimed at a study of both. For the first, lateral roentgenograms are made in repose (with the patient lying on the outer side of the leg) and during weight bearing (the patient standing on his foot and the film being exposed laterally). For the second, pedograms (foot prints) are taken in repose and during weight bearing, then the patient is stood on the film holder and an anteroposterior view of the foot is made by the double exposure method.

The position of the plantar arch and its deviation from normal is determined by measuring the distance from the base to the apex of the triangle formed by lines extending along the plantar aspect of the foot laterally. The base extends from the head of the

fifth metatarsal to the posterior plantar angle of the os calcis. The posterior side of the triangle connects the plantar eminences of the os calcis and the anterior side extending from the plantar aspect of the head of the fifth metatarsal through the plantar aspect of the proximal end of the fifth metatarsal (Fig. 1). The outer longitudinal arch of the foot is measured in this manner because of the greater simplicity. However, a comparison with the inner longitudinal arch in a certain number of cases shows that it represents just as true an indicator of the degree of involvement as the inner longitudinal arch.

After correlation with the clinical examination, the following figures (during weight bearing) were set up as indicative of the degree of pes planus: 1.0 cm. or above, normal; from 0.7 to 0.9 cm., first degree; from 0.4 to 0.6 cm., second degree; from 0.2 to 0.3 cm., third degree; and from 0.1 to 0.1 cm., fourth degree.

The pronation of the foot is determined on the basis of the enumerated criteria of Morton, as visualized on the pedograms and double exposure roentgenograms (Fig. 2).

Altogether the authors examined 400 subjects.

The findings in respect to pes planus were coordinated with the clinical findings. They are summarized in Table I.

The pronation studies gave the following results:

Of the cases which appeared clinically and roentgenologically negative for pes planus, 57 per cent



TABLE I. COMPARISON OF  
CLINICAL AND ROENTGEN FINDINGS

Clinical Diagnosis	Roentgen Diagnosis				
	Normal%	First Degree%	Second Degree%	Third Degree%	Fourth Degree%
Normal	17	24	37	16	6
First Degree	9	36	39	7	6
Second Degree	9	36	35	15	5
Third Degree	8	25	46	15	6

showed pronation on the films and pedograms. Sixty-five per cent of the cases diagnosed clinically as pes planus were negative for pes planus on roentgen examination but showed pronation. Of the cases with roentgen evidence of pronation, 61 per cent were negative for pes planus, 17 per cent showed first degree pes planus, 10 per cent second-degree, and 5 per cent fourth degree.

It was further noted that the incidence of flat feet and pronated feet was higher among colored persons (90 per cent) than among whites (72 per cent), and that, contrary to the findings of other investigators, overweight of 10 pounds or more did not seem to be a factor in the incidence. T. LEUCUTIA, M.D.

Compere, E. L.: Flat Feet in Children. *Med Clin. N. America*, 1946, 30: 147.

This article attempts to place the proper emphasis upon the various foot ailments of children.

Many flat feet in children are normal and will stand as much hard usage as the feet with normal arches. Mild "pigeon toe" of children need usually cause no concern, for it means that the child is automatically going about the business of strengthening the arches of his feet.

Painful feet in children are not common. They may occur in arthritis, in chronic strain (which is seen in high arches more than in low ones), and in acute strains which may result from jumps or falls. The practice of keeping children's feet incased in stiff shoes results in the wasting of the intrinsic foot muscles until they no longer protect and support the various components of the foot.

The fundamental mechanics of the foot are discussed briefly, and it is pointed out that most of the common adult foot problems have their inception in childhood, especially if the intrinsic muscles are allowed to waste in unyielding shoes. The attempt to strengthen the muscles through exercises for a short period each day is termed mere "toe twiddling." Good oxfords and plenty of normal play activity are the best treatment for uncomplicated flexible, painless flatfeet, and children should be encouraged to play in their bare feet in good weather and on favorable terrain.

The recommended footwear is the oxford or sandal with strong leather soles, plenty of toe room, and lack of constriction of the circulation at the vamp.

The reinforced counter, extending forward to the scaphoid bone is advised. For the everted heel, a Thomas heel with an  $\frac{3}{8}$  inch wedge on its inner side is suggested. If genu valgum is present the wedge should be  $\frac{3}{4}$  inch high.

High top shoes, splinting of the ankle, and the prevention of normal development of the muscles, are referred to as a "vicious tradition." Metal plates are rarely required in these days when good orthopedic footwear is readily obtainable in retail stores. The acutely painful flatfoot, associated with marked disturbance in weightbearing alignment may require surgical treatment. Manipulation under anesthesia and the application of a walking plaster cast to maintain a position of inversion for from 3 to 6 weeks will suffice in a few cases, but in more severe cases arthrodesis of the midtarsal joints is indicated especially when anxious mothers, who become concerned about their children's feet through reading the lay magazines, may need more reassurance than their children with supposedly flat feet need treatment. NEWTON C. MEAD, M.D.

#### SURGERY OF THE BONES, JOINTS, MUSCLES, TENDONS, ETC.

Rose, T. F., and Newson, A.: Early Results of the Treatment of Gunshot Wounds of Limb Joints, Aided by Penicillin Therapy. *Med J. Australia*, 1946, 1: 75.

This article brings out the results obtained in the treatment of 66 gunshot wounds of the limb joints. The casualties were followed up for at least 5 weeks. The wounds are classified as: (1) those in which the capsule and synovial membrane only were involved. (2) those in which involvement of the capsule and synovial membrane, in addition to the bone ends, were damaged and there was a minimum cartilage loss and fragment displacement; and (3) those in which the joints were completely disorganized.

In this series there were 12 cases of the first type, 12 of the second, and 40 of the third. Blood serum and whole blood were given liberally. X-rays were taken routinely, if possible, before surgery. Pentothal was used for anesthesia routinely. When fluid or blood was aspirated from the joint cavity, penicillin was instilled. The patella was conserved if the articular surface was not impaired. In all operations upon the knee joint, 100,000 units of penicillin were instilled into the joint before the last capsular suture was tied. When it was impossible to close the joint, the wound was left open and gauze was packed down to the joint and soaked with 1:1,000 "monacrin" solution. This gauze was changed every third day until the joint could be closed. Intra-articular foreign bodies were localized and removed as soon as possible. When infected wounds were seen, or infected tissues were excised, penicillin was used liberally, both locally and parenterally. A 1:1,000 "monacrin" solution was used locally in all infected wounds. This antiseptic was efficacious not only against the pyogenic cocci but also against the bacilli.

coli communis and, to a lesser extent, to the bacillus proteus. It has no effect on the pseudomonas pyocyaneus, but when this was present "monacrin" was combined with acetic acid (2%).

Immobilization was used according to routine methods, and the joints were made accessible through a window in the cast for treatment. Movement of these joints was commenced when compatible with the injury and the progress made.

The cases are discussed and the results obtained are listed. Four complete tables are presented, showing the joint involved, the treatment used, and the ultimate result. The infections are discussed. It is not inferred that the treatment used saved limbs and joints beyond a reasonable degree in view of the structural damage sustained; however, this method of treatment gave excellent results and many limbs and joints that otherwise may have been lost were made useful.

RICHARD J. BENNETT, JR., M.D.

### FRACTURES AND DISLOCATIONS

Leveton, A.L.: March (Fatigue) Fractures of the Long Bones of the Lower Extremity and Pelvis  
*Am. J. Surg.*, 1946, 71: 222.

Twelve cases of march fracture of the long bones (exclusive of the metatarsals) and of the pelvic bones encountered during a 9 months' period in an army station hospital are reviewed in detail. The bones involved, in order of frequency, were the tibia (6 cases), the pelvis (3 cases), the femur (2 cases), and the fibula, (1 case). The author subscribes to the belief that these fractures are merely the response of the weight bearing skeletal frame to continuous overstrain.

There is a characteristic predilection of the site of these fractures. The tibias are usually fractured about 3 inches distal to the upper end, the fibulas generally fracture in the upper third or at the lower end, and the femurs are usually involved about 3 inches above the joint line or at the neck. The 6 tibial fractures occurred in healthy trainees 18 or 19 years of age.

The period of pain before hospitalization was quite prolonged, varying from 14 to 70 days. The symptoms began as vague pain chiefly referred to the knee, with muscle tenderness and stiffness, and bone tenderness in the upper third of the medial aspect. Later there was swelling with pitting edema and some increased heat and rubor. In general, the roentgenograms may be negative in the early stages but later there is usually some periosteal thickening on the medial and posterior aspects of the tibia. The fracture then tends to spread throughout the diameter of the bone as a crack in ice would spread. Old cases show an area of increased density in the area of the fracture. Complete fracture with displacement may result if march fractures are not protected until they are solidly healed.

Treatment may be carried out without casts or other immobilization if the patient remains at complete bed rest for from 8 to 12 weeks. Physical therapy is helpful in rehabilitation. In cases of march fracture of the femoral neck a double spica cast may be used to prevent coxa vara.

The pelvic march fractures, which show a predilection for the inferior ramus of the pubis, respond to bed rest until adduction spasm has subsided, then limited activity may be permitted until healing is complete.

NEWTON C. MEAB, M.D.

# SURGERY OF THE BLOOD AND LYMPH SYSTEMS

## BLOOD VESSELS

Naide, M., and Sayen, A.: *Venospasm. Its Part in Producing the Clinical Picture of Raynaud's Disease.* *Arch. Int. M.*, 1946, 77: 16.

The authors note that although many hundreds of papers have been written on Raynaud's disease, there is still no clear cut clinical concept of the mechanism involved nor an explanation for the varied pictures which are all classified under this term. The problem has been further complicated by the introduction of the term "Raynaud's phenomenon," since there is no agreement as to just what differentiates Raynaud's disease from Raynaud's phenomenon. Certain observations that have been made have raised the question whether arterial spasm can explain the entire picture of Raynaud's disease. These observations have made it possible to separate patients with the syndrome into several groups on the basis of their clinical behavior, and have added clarity to the diagnosis and treatment.

The author presents a classified group of venospasm disorders and a report in detail of 2 cases. The confusion that exists in interpreting the series of events in patients with Raynaud's disease and with Raynaud's phenomenon has arisen from failure to consider that the veins often partake in the pathological spasm.

A variety of pathological states are created by venospasm. The severe edema of thrombophlebitis is thought to be caused by the constriction of many veins in the extremity as a result of reflexes set up in the one segment of vein which is inflamed and in a state of irritability. It is also recognized that the venous congestion that occurs in thrombophlebitis initiates reflex arterial constriction. This is a necessary and useful reflex to prevent the continued swelling of the extremity which would occur if the arteries remained dilated, and it tends to prevent extreme edema when veins are obstructed or in spasm. Moreover, simply congesting the veins in one extremity causes widespread changes in tone of both arteries and veins in the contralateral as well as in the same extremity.

This impression was a basic factor in 2 patients with Raynaud's disease studied by the authors. The appearance of cyanosis and puffiness at the beginning of an attack in some patients suggests that venospasm occurs first, and that then, with distention of venules and capillaries distal to the spastic veins, reflex arterial constriction is initiated to prevent the swelling and congestion that would occur if the arteries remained unconstricted or dilated. An anatomic factor that fits into this concept of what may be happening in some patients with Raynaud's disease is that the veins in the hands are more superficially placed and are the first to be exposed to a stimulus such as cold.

In addition to an exaggerated constriction of veins and arteries from cold and emotional tension, as an explanation of the clinical picture in Raynaud's disease and in Raynaud's phenomenon, there is another factor that must be considered; that is, the possibility that in some of these patients the capacity for venous outflow is not as great as it should be in relation to the capacity for arterial inflow. It is possible that there may be an imbalance between arterial and venous flow. There is great variation in the caliber of veins in the hands and arms in different persons. Many of the patients with Raynaud's disease have small veins. A disproportion in the caliber of arteries and veins may in itself largely explain the cyanosis and puffiness. This is confirmed by the fact that cyanosis persists after sympathectomy in patients with Raynaud's disease, and may even increase.

A tendency to an exaggerated constriction of digital vessels is not uncommon. There is a tremendous range in vascular tone in the hands of normal persons. Failure to realize that there is also a wide range in abnormal digital constriction from cold and emotional tension has given an undeservedly serious connotation to the diagnosis of Raynaud's disease. The great majority of these persons have only mild symptoms, which do not increase in severity. It is only those with the severest grades of digital vasoconstriction who require sympathectomy. In the milder forms of Raynaud's spasm, reassurance is sufficient, together with mild vasodilator therapy. The authors have been impressed by the presence of factors that maintain a high degree of nervous tension in practically all patients with Raynaud's disease.

The program of management includes avoidance of exposure to severe cold, wearing of warmer clothing than that worn by the average person, taking of a warm tub bath daily in a warm bathroom, abstinence from tobacco, and use of an adequate diet. The use of thyroid substance is of value, since even a slightly reduced basal metabolic rate will aggravate a tendency to peripheral vasoconstriction in response to cold. Estrogen therapy is useful when Raynaud's disease occurs during the menopause.

In conclusion the authors state that their observation of 10 patients with Raynaud's disease and 4 patients with Raynaud's phenomenon revealed that spasm of the veins as well as of the arteries is present in the majority of these patients. Arterial spasm alone cannot explain the clinical picture in most patients. In some patients venospasm may predominate over arterial spasm. The clinical features in each patient will vary with the part of the vascular tree that is predominantly involved in the abnormal vasoconstriction.

In some patients with Raynaud's disease the clinical picture is influenced by an anatomic dispro-

portion in capacity between arterial and venous flow. On the basis of clinical observations of these patients during the test for basal vascular tone, the authors present a classification to clarify the terms "Raynaud's disease" and "Raynaud's phenomenon."

Raynaud's disease is not rare. The milder forms are fairly common and do not deserve the connotation of seriousness usually associated with the diagnosis. Reassurance is an important part of treatment. In a patient with so called cold allergy, venospasm was found to develop on exposure to cold without development of arterial constriction, which explained the development of cyanosis and pronounced swelling without blanching. HERBERT F. THURSTON, M.D.

Kilbourne, E. D., and Wolff, H. G.: Cranial Arteritis: A Critical Evaluation of the Syndrome of "Temporal Arteritis," with the Report of a Case. *Ann. Int. M.*, 1946, 24: 1.

The syndrome heretofore designated as "temporal arteritis" is a well defined syndrome occurring in aged people of the white race. It was first described in 1932 by Horton, McGath, and Brown, and since that time 20 case reports have appeared in the literature. All but one of the patients studied presented signs and symptoms associated with infection; namely, anorexia, prostration, fever, sweats, weight loss, and leucocytosis, and locally, over the artery there was heat, swelling, tenderness, redness, and pain. The distribution of the pain and tenderness is indicative of preceding or concurrent inflammation of arteries of the lower half of the head. In half of the authors' patients, pain over the distribution of these arteries was primary. In more than half of the patients studied there was evidence of preceding or concomitant infection in the head, suggesting the possibility of spread of this infection by contiguity along the walls of the branches of the external carotid artery.

Differentiation of "temporal arteritis" from periarteritis nodosa cannot be made from the study of histopathological sections of the diseased arteries. Although in many cases of "temporal arteritis" giant cells are found, in some cases, eosinophilic infiltration, in the absence of giant cells, has occurred.

The authors give a very complete case study of a 68 year old man, and then give their concept of the etiology and pathogenesis of the syndrome. They believe that the term "temporal arteritis" is misleading, since it is probable that the disease involves other arteries of the head. Therefore, they propose the term "cranial arteritis" as the proper name for the syndrome heretofore known as "temporal arteritis." They feel that "cranial arteritis" is a much more definitive and inclusive descriptive title.

PAUL MERRELL, M.D.

Logue, R. B., and Mullins, F.: Polyarteritis Nodosa; Report of 11 Cases with a Review of the Recent Literature. *Ann. Int. M.*, 1946, 24: 11.

Periarteritis nodosa is an obliterative, inflammatory, vascular disease involving the small arteries

and arterioles. The authors point out that the name periarteritis nodosa is an inadequate descriptive term since all coats of the vessel are involved. They believe that polyarteritis is a more exact name. The etiology is unknown. Pathological lesions are quite variable and it is obvious that their occurrence will depend upon the vessels involved in any given case. The tissues involved, in order of frequency, are: the kidneys (80%), the heart (60%), the liver (47%), the spleen, lungs, mesentery, peripheral nerves, the skin, and the brain. Three hundred and fifty cases had been reported up to 1942. Males are affected more than females, and the disease may occur at any age, the patients whose cases are reported being from 1 to 79 years old. Fifty per cent of the patients, however, are in the fourth and fifth decades of life. Cures are infrequent, the mortality rate being as high as from 90 to 95 per cent.

The symptomatology may be extremely variable and depend upon the tissues involved. The authors have worked out the percentages of some of the symptoms as they have occurred in the reported series of 177 cases. The laboratory findings revealed leucocytosis with a mild shift to the left in the active stages of the disease. A finding of eosinophiles is extremely variable. The sedimentation rate is commonly elevated. Anemia is common in the later stages. Hematuria and albuminuria are frequent.

While arteritis nodosa is of gradual onset, it may last for a period of months or years. The course of the disease may be punctuated by periods of remission and relapse.

The authors report 11 cases of their own (10 males and 1 female) with complete case histories. They point out that the duration of the illness varied from 2½ months to 1 year. One of their patients in whom the diagnosis of arteritis nodosa was made more than 2 years ago, is still living.

PAUL MERRELL, M.D.

Rosenstein, P.: New Findings with Respect to the Nature, Prevention, and Treatment of Thrombosis and Embolism (Novas pesquisas a respeito da natureza, da prevenção e do tratamento da trombose e da embolia). *Rev. brasil. med.*, 1945, 2: 734.

The author believes that with the knowledge now at hand a rational prophylaxis and treatment of thrombosis should be feasible, and should result in a reduction in the number of fatalities due to this condition. He omits all purely theoretical considerations in this field as not having as yet reached the stage which would be of value to the practitioner in medicine. The condition is of interest to all practicing physicians, since statistics show that fatal pulmonary embolism results almost as often from the thromboses arising in medical conditions, as in those following surgery and gynecological procedures. Of prime importance, of course, is the incidence of thrombosis in general, and it is particularly important to ascertain if the condition is on the increase.



## BLOOD; TRANSFUSION

Simmons, R. T., Jakobowicz, R., and Kelsall, G. A.: The Rh Factor: A Survey of the Subtypes of White Australians. *Med. J. Australia*, 1945, 2: 493.

The Rh typing was performed by the authors in three different laboratories on 350 blood samples of groups O and A only. The blood specimens were not entirely a random sample of the two blood groups, as three families were included in the series.

The tests were carried out with anti Rh typing serum. The laboratory which used the American typing serum did 125 tests by the tube technique. The authors describe in detail the methods used in these examinations. The percentages of the results obtained were: Rh negative, 14.86; Rh<sup>0</sup>, 54.0; Rh<sup>0</sup>′, 12.57; Rh<sup>0</sup>′ Rh<sup>0</sup>′, 16.57; Rh<sup>0</sup>, 0.57; Rh, 0.86; and Rh<sup>0</sup>, 0.57.

The authors note that recent figures for a total of 10,000 random samples of blood from Red Cross donors in Melbourne, tested with anti Rh<sup>0</sup> and anti Rh<sup>0</sup>′ serum, indicate that the blood of approximately 16.4 per cent of the persons tested was Rh negative. If anti Rh<sup>0</sup>′ serum had been used in the above Rh testing, the number of persons found whose blood contained the agglutinating Rh<sup>0</sup>′ would not have altered appreciably the Rh negative percentage of 16.4 per cent. An Rh negative percentage of 16.59 was found in a small series run in England. This was slightly higher than that found in a much larger sample. The Australian and English percentages, therefore, do not greatly differ, but are higher than the Rh negative percentage found in America for white persons.

Until recently the Rh<sup>0</sup> antigen has been known as Rh, Rh<sub>0</sub>, or the Rh factor; but after the discovery of Rh subtypes it was renamed Rh<sub>0</sub>, or Rh<sup>0</sup>, as Rh was taken to have a much wider meaning. This is the antigen common to the rhesus monkey and to about 85 per cent of white people. It appears to be the antigen responsible for the agglutinating antibody Rh<sup>0</sup>, and for the blocking antibody which so far has been found to be specific against the Rh<sup>0</sup> element in the erythrocytes. In whites it usually occurs in combination with another partial antigen, but uncombined, its occurrence in whites in New York City was 2.4 per cent, whereas the figure in England and Australia is under 1 per cent. It is found that among selected American negroes the percentage of Rh<sup>0</sup> was as high as 41.6 per cent, and among unselected negroes, 24.5 per cent.

Occurring alone, Rh<sup>0</sup> is a rare subtype, but in combination with Rh<sup>0</sup> it is found in 70 per cent of whites and was previously designated Rh<sub>1</sub>; now, to avoid any ambiguity, and to be consistent with modern genetic terminology, it is named Rh<sup>0</sup>′.

Rh<sup>0</sup>′ is a very rare subtype when occurring alone, but combined with Rh<sup>0</sup> it is found in 30 per cent of whites; it was called Rh<sub>2</sub>, and is now named Rh<sup>0</sup>′′. All of the three types, Rh<sub>0</sub>, Rh<sup>0</sup>′ and Rh<sup>0</sup>′′ react specifically with their corresponding antibodies.

In whites the Rh negative occurs in approximately 13 per cent of all persons, whereas in American negroes it is found in about 7.3 per cent. In other races it has been shown to be absent or very rare.

In conclusion, the authors state that the blocking antibody which has been recognized only recently, is of extreme importance. In the first place it cannot be detected by the usual agglutinating technique; secondly, it can exert a lethal effect upon the child of a mother whose serum contains it, and may cause hemolytic reactions from transfusion of apparently compatible blood; thirdly, it may occur together with the agglutinating antibody in the same person's serum and may mask the presence of the agglutinating antibody; and finally, it is regarded as having some effect in the prozone phenomenon.

In a high percentage of cases of hemolytic disease of the newborn, an agglutinating antibody can be demonstrated; but the blocking antibody will probably be found to be responsible for many of the remaining cases. The danger of the blocking antibody lies in the difficulty of its detection. For transfusion purposes crossmatching will not detect the blocking antibody, and its suspected presence will necessitate the full test. If blocking antibodies are present, no agglutination will occur, or the expected clumping will be much weakened. To appreciate the action of the blocking antibody, it can be regarded as an incomplete antibody, which in itself does not cause agglutination, but which places a protective coating on the cell to inhibit the action of the agglutinating anti Rh<sub>0</sub> antibody. It should be noted that so far it has been found to be specific only in inhibiting anti Rh<sup>0</sup>′ agglutinating antibody, anti Rh<sup>0</sup>′ and anti Rh<sup>0</sup>′′ antibody being unaffected by it.

The authors present briefly the technique of unmasking the presence of an agglutinating antibody in a specimen of serum suspected of containing both agglutinating and blocking antibodies. It is not clear whether the blocking antibody arises in response to the anti Rh<sub>0</sub> antigen or whether it arises in response to immunization by a special antigen of its own. It is possible to make use of the specificity of the blocking antibody, which is anti Rh<sub>0</sub>, by adding it to a strong polyvalent antiserum, for example, anti Rh<sub>0</sub>, Rh<sup>0</sup>′ to mask the anti Rh<sub>0</sub> agglutinin, leaving an active subtype anti Rh<sup>0</sup>′ serum. This is the method recommended for the preparation of monovalent subtype serum from polyvalent antiserum.

HERBERT F. THURSTON, M.D.

Callender, S., and Paykoc, Z. V.: Irregular Hemagglutinins after Transfusion. *Brit. M. J.*, 1946, 1: 219.

The development of irregular hemagglutinins, both as a result of isoimmunization in pregnancy and after repeated blood transfusions, is now well recognized, the familiar example being the immunization of the Rh-negative patient to an Rh-positive fetus or Rh-positive transfusion. During the past year, in an attempt to detect and identify such irregular agglu-

tinins, the authors have made a systematic study of 100 patients receiving transfusions. There were 52 women and 48 men in the series.

The majority of the patients were routine admissions to the medical wards, but one of the wards is associated with a research department, and a relatively high proportion of the patients in this ward suffered from blood diseases requiring repeated transfusions. Seven patients from nonmedical wards were also investigated, either because they had shown a transfusion reaction or because they were known to be Rh-negative. In all there were 37 cases of hematemesis; 14 of ulcerative colitis; 31 of blood dyscrasias, 7 of which were cases of aplastic anemia; 4 were healthy volunteers who were being bled and transfused for red cell survival experiments. The remaining 14 patients suffered from various conditions such as battle injuries, sepsis, and menorrhagia.

The authors discuss the methods they used in studying these patients from the standpoint of arteries, physical findings, blood groups, obstetrical history, and reactions. They report 3 cases, discuss the findings, and present their conclusions as follows:

Of 100 patients transfused with 958 pints (544.1) of blood, 2 patients were shown to have developed irregular agglutinins.

One Rh-negative patient developed anti-Rh (symbol) after a single transfusion without previous isoimmunization by pregnancy.

One Rh-positive patient developed St ( $\gamma$  Fisher) and 3 new antibodies, all active at 37° C.

Cold agglutinins were found in the sera of 88 of 95 patients examined, in titers of 1 to 128. In 15 of these the agglutinins were also active at room temperature.

In 2 patients an agglutinin was found which was active at 37° C and reacted with the patients' own cells only.

PAUL MERRELL, M.D.

Murphy, H. M.: The Transmission of Infectious Hepatitis by Blood Transfusion; A Report of 2 Cases. *Gastroenterology*, 1945, 5: 449.

Two cases of infectious hepatitis are reported following the transfusion of blood from donors who on the same day and the following day developed clinical symptoms of infectious hepatitis. The disease then was observed to develop in both recipients 24 and 47 days, respectively, following the transfusion. In the case showing the shorter incubation period, laboratory and physical findings were present from the seventeenth post-transfusion day although clinical symptoms (an abrupt rise in temperature, headache, and malaise) did not occur until the twenty-fourth day. The icteric index returned to normal in 7 weeks.

The second patient had received several other transfusions. Forty-five days after the transfusion only a slight elevation of the phosphatase was observed. Clinical symptoms (anorexia and nausea) occurred on the forty-seventh day. He then developed jaundice which persisted, although his systemic symptoms disappeared 2 days later. The duration of the disease was not known as the patient was evacuated.

As to the short incubation period in the first case, it was mentioned that he had been in Italy for several months and many cases of hepatitis had occurred in his organization, therefore he may have already had the disease at the time of the transfusion. The donor in this case died and therefore the virulence of the agent is also questionable.

The incubation period is discussed and the reports of several investigators are reviewed.

Prospective donors with a history of hepatitis should not be used. Accidents such as the 2 described are unavoidable when large numbers of transfusions are being given in an area where hepatitis is epidemic. THOMAS C. DOUGLASS, M.D.

# SURGICAL TECHNIQUE

## OPERATIVE SURGERY AND TECHNIQUE; POSTOPERATIVE TREATMENT

Robertson, C. K.: Postoperative Pulmonary Complications. *Edinburgh M. J.*, 1945, 52: 460.

Irritative conditions, e.g., acute tracheobronchitis, embolic manifestations, atelectatic phenomena, and acute pulmonary edema, are the most frequent postoperative pulmonary complications.

Among 1,819 cases of all gynecological types operated on during a 2 year period, only 20 developed pulmonary complications which were serious. Of this group of 20, 11 were cases of pulmonary embolism, 7 of acute bronchitis, 1 was empyema of a pneumococcal type, and 1 was pulmonary edema.

The average age for the development of pulmonary embolism was 47 years. The attack occurred on the tenth or eleventh postoperative day. The clinical features were typical. There was a premonitory increase in the pulse, temperature, and respiration, followed by pleural pain in the affected part. An early slight unproductive cough may appear before there is any complaint. The sputum was bloodstained in only 6 of the 11 cases. The possibility of the development of pneumonia in the affected area is fast disappearing because of the early use of sulfonamides.

Treatment is empirical. The pain must be allayed, the shock counteracted, and the general circulation improved, since some degree of cardiovascular insufficiency is present in most patients with pulmonary embolism.

Synthetic anticoagulants, like dicoumarin or dicoumarin plus heparin, must, in the future, play an important part in the prophylaxis of such ailments. Other preventive measures should include: (1) early active and passive movement on the part of the patient, as soon as consistent with comfort after the operation; (2) enforced hyperventilation of the lungs by deep breathing exercises; and (3) the reduction of the use of narcotics to a minimum.

Collapse of the lung occurs only when there is absolute bronchial occlusion; the more viscid the sputum, the greater is the tendency toward collapse. Since the unimpaired circulation of blood in the lungs is also an important factor in the production of collapse, the condition arises most frequently in young healthy adults. The clinical features of collapse are outstanding and dramatic in their suddenness, so that the diagnosis is not difficult. The differential diagnosis must be made from pulmonary embolism, lobar pneumonia, and spontaneous pneumothorax. In collapse, in addition to the local dullness, the mediastinal shift, and the absent or weak tubular breath sounds, the respiration is jerky, twitching, or spasmodic because of tonic irritative contractions of the diaphragm.

The treatment in collapse is to displace the plug of viscid mucus by simple postural coughing and by having the patient take deep breaths. Drugs are of little avail, but sulfonamides should be given prophylactically.

Acute pulmonary edema is due to the seepage of a serous transudate through not only the active capillary bed of the lungs but through the whole of the reserve capillary structure as well. The factors which play a part in the production of this condition are (1) hypoventilation with resultant lung rigidity, (2) impaired circulation, with consequent lack of proper oxygenation, and (3) a possible temporary reduction in the output of the left ventricle, which upsets the fine degree of balance existing between the two chambers of the heart, which is so essential for normal pulmonary circulation.

The treatment of pulmonary edema consists in the use of (1) oxygen, (2) venesection, (3) morphine, and (4) atropine. SAMUEL KAHN, M.D.

Grandstaff, E. H.: A New Treatment for Postoperative Pulmonary Collapse. *Arch. Surg.*, 1945, 51: 237.

The author reviewed the records of postoperative pulmonary complications at the Kansas City General Hospital, Kansas City, Missouri, for a 2 year period and found that of 2,704 patients given an anesthetic, 6 developed massive pulmonary collapse, 15 atelectasis, and 51 pneumonia. All patients with collapse or atelectasis recovered quickly; 24 of those with pneumonia, in most of whom it was a terminal affair, died.

The causes of postoperative pulmonary collapse are discussed; among them are pain from the incision in abdominal operations, splinting of the lower intercostal muscles, interference with respiration by kidney rests, oral sepsis and acute or chronic infections of the respiratory tract, and excessive postoperative sedation. Two other factors are stressed. One is that failure to wait for premedication to take effect means starting the anesthetic before the maximum anhidrotic effect of atropine or scopolamine has been attained. The other factor is the anesthetic agent. Ether is irritating to the bronchial mucosa and stimulates the production of secretion. The oxygen-rich atmosphere behind an obstructing mucus plug is quickly absorbed, and leaves a small portion of collapsed lung. Cyclopropane produces very little bronchial irritation and less vomiting than ether, hence less possibility of aspiration.

Collapse occurs suddenly, a day or so after operation. It is characterized by chest pain, dyspnea, sharp rise in the temperature, pulse, and respiration. The physical findings are dullness over the affected side, absence of breath sounds, some fixation of the affected side of the chest, elevation of the diaphragm on the same side, and a shift of the area of cardiac



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dullness toward it. Sputum, at first scanty, soon becomes profuse and mucopurulent. The white count is between 15,000 and 20,000. The twelfth-gram is characteristic, showing narrowed intercostal spaces and an elevated diaphragm on the affected side, deviation of the heart shadow toward it, and a dense homogeneous lung.

Treatment is primarily prophylactic. Premedication should be closely correlated with the type of anesthetic to be given. Before the patient leaves the operating room he should be partially awake, at least to the extent that his pharyngeal reflex has been restored. After he has been returned to his bed, frequent changes of position, inhalations of carbon dioxide and oxygen, deep breathing exercises, and minimal sedation are important precautions.

However, when, in spite of precautions, collapse has occurred, the author has had complete success with a new method of therapy, which he describes. A cotton ball is soaked in from 5 to 10 per cent cocaine. This pledget, held in a curved applicator, is placed far back in the throat and into the pyriform sinuses, as it is in preparation for a bronchoscopy. This pledget partially relaxes the bronchial tree sufficiently that within a few minutes the patient coughs up the offending mucus plug. The use of a little solution of epinephrine in the same pledget will stimulate the cough reflex. Voluntary attempts at coughing are to be encouraged. After the obstruction has been expelled, inhalations are given for at least 24 hours and the patient is given a set of blow bottles to insure continued aeration of the involved lung. If chemotherapy—sulfathiazole or sulfadiazine—is instituted at the time the diagnosis is made it helps to prevent the occurrence of pneumonia in the unrespirated lung. The author has had no failures with this method and hence has had no resort to the more formidable procedure of bronchoscopy.

H. F. LOEWENBERG, M.D.

Jacobi, M., Klein, B., Rascoff, H., and Kogut, B.: Effect of the Intravenous Administration of Oxygen on Shock in Dogs and in Human Beings. *Arch Surg.* 1945, 52: 42.

One hundred per cent oxygen has been reported to be beneficial in the treatment of shock. Reasoning from this report and the relatively small quantity of oxygen utilized when inhaled, the authors believed that oxygen could be given more efficiently intravenously. They believe that the previous discouraging reports were due to the use of too great a quantity, too rapid administration, or administration at too high a pressure.

Irreversible shock was produced in 12 dogs by the intravenous injection of a saline extract of dog muscle (Moon). Three of these dogs received no treatment and died in from 5 to 7 hours. Three were treated and died in from 5 to 7 hours. All of them showed marked hemocoagulation. The remaining 6 dogs and lived from 10 to 11 hours. They were treated by oxygen given intravenously, by means of a modified apparatus described by Lignier.

at the rate of 100 c.c. per hour. Treatment was stopped prematurely on one dog; a relapse and death followed. The 5 other dogs were treated from 15 to 24 hours with reduction in hemocoagulation and recovery. At autopsy no evidence of air embolism was noted.

Three cases of severe shock are reported in patients in whom all the usual methods of treatment had failed. The intravenous injection of oxygen then resulted in prompt recovery of all 3. One of these patients had been subjected to a difficult subtotal resection for an advanced carcinoma of the stomach. In this case oxygen was given at the rate of 600 c.c. per hour and was continued for 30 hours.

The 2 other cases reported were severe birth injuries which appeared to be hopeless at neither responded to the usual therapeutic measures. Response to 90 c.c. of oxygen per hour in one and to 100 c.c. per hour in the other was prompt and dramatic, in a minutes in the first case and in 15 minutes in the second case. The first baby died 3 weeks later of a pneumococcal meningitis. The second died 3 days postpartum of a subdural hematoma. Neither showed any evidence of air embolism.

THOMAS C. DOUGLASS, M.D.

## ANTISEPTIC SURGERY; TREATMENT OF WOUNDS AND INFECTIONS

Rawles, D. W., Jr.: Repair of Soft Tissue Wounds. *Ann Surg.* 1945, 121: 209.

The author states that from 85 to 90 per cent of uncomplicated soft tissue wounds can be closed successfully in from 4 to 10 days after adequate debridement. This policy of early closure was generally adopted in the winter of 1913-14. At first, complicated wounds were so treated, but later, with penicillin and blood replacement, extensive and complicated wounds were closed. The general principles have been reported by Churchill. The present article deals with the experiences of a general hospital in this theatre.

The goal of early closure is to create a closed wound so that men may be returned to duty earlier, or so that reconstructive surgery may be accomplished sooner.

Repair may be undertaken (a) early (4 to 10 days), (b) late (after 10 days), and (c) by a planned stage method to be described. Wounds may be closed by (1) approximation of skin edges, (2) skin grafts, (3) simple plastic procedures, and (4) combinations of the three.

Early repair is more successful because of the low incidence of infection, ease of accomplishment, and minimal scar tissue formation. Contraindications to early closure are evidences of frank infection. Infected cases were allowed to "clean up" (1) with moist resilient pressure dressings, and (2) removal of devitalized tissue and drainage of pus pockets, followed by repair in 4 to 6 days after penicillin

therapy and blood replacement, if necessary. The original dressing, which was applied following débridement, was usually not changed until repair was attempted.

Of some 601 wounds in 422 battle casualties, 391 were closed early (in less than 12 days) and 300 late (over 12 days). In the first group, 94.6 per cent healed almost per primam; in the group closed late, 60 were closed by simple approximation, 61.7 per cent healing per primam; and 240 were either partially or totally excised before closure, 75 per cent of them healing per primam.

Patients with soft tissue wounds usually reached the general hospital on from the third to the fifth day, and their wounds were closed as soon as possible after temperature, blood, and x-ray studies could be made, and the fatigue of travel had been relieved by rest. Blood was replaced when indicated. Clinical judgment rather than bacterial studies determined whether the wound should be closed, since the authors knew they were contaminated, and further delay occasioned by cultures would have carried these wounds past the optimum time for closure.

Intravenous sodium pentothal was used in most cases, but in patients whose repairs extended over a period of more than 30 minutes, nitrous oxide ether inhalation anesthesia was administered. Blood clots, if present, were carefully removed; foreign bodies were removed only if readily accessible, or if it was thought they would interfere with vital structures. Most wounds were closed by simple approximation of the skin edges. After a few days, wound edges have a tendency to curl down, and in cases in which this occurred, they were gently freed with a blunt instrument before closure.

When wounds are closed early, moderate tension may be used because as soon as the wound is closed the edema subsides and the tension lessens before any strangulation of incorporated tissue can take place. An attempt was made to encompass the wound to eliminate dead space. Drainage was employed only rarely, when deep pockets could not be obliterated or when there was profuse drainage from a long perforating wound, in which cases rubber tissue was used.

Skin grafting was employed when the wound edges could not be approximated. Split-skin grafts were used in preference to rotation or advancement. Complicated plastic procedures are best undertaken after wounds have healed, and here again resilient pressure dressings were used.

Closure after the tenth day was not by choice, but was occasioned by late evacuation, as in chest and abdominal wounds, or by other complications such as infection. In small wounds excision was best, whereas, in the larger ones excision of the wound edges, with undercutting and approximation by suture or graft, was done. Less success could be expected in these late cases.

In the planned stage method, some of the wounds, because of infection or the presence of devitalized tissue, were secondarily débrided and then closed 5

days later under protection of penicillin and blood replacement. Resilient pressure dressings and splinting of adjacent joints were essential to good healing. Penicillin was a valuable adjunct to successful reparative surgery and, particularly, a safeguard against clostridial myositis.

Early intensive mental and physical reconditioning was necessary if men were to be returned to combat.

BYRON T. HUSKETT, M.D.

#### Hamrick, W. H.: Suture of the Fingernail in Crushing Injuries. *U. S. Nav. M. Bull.*, 1946, 46: 225.

In certain injuries of the finger tip, when the nail root has been avulsed but the distal part of the nail remains partially attached to its bed, the remaining portion of the nail may be utilized as a protective covering by suturing directly through the nail. A typical injury for which this method of treatment can be employed to advantage consists of avulsion of the nail root, with the distal three-fourths of the nail partly attached and the phalanx fractured. The trauma is usually caused by the sharp edge of a slammed window, car door, or frequently by a cutting tool in industry. A palmar bridge of soft tissue is often all that remains of what was almost a complete amputation.

Block anesthesia is secured at the base of the finger, which is then cleansed thoroughly with ether, green soap, and sterile saline solution. Hemostasis is effected temporarily by small hemostats after initial débridement. The nail root is transected with a scissors, and the proximal edge of the remaining distal attached nail is trimmed to fit the curvature of the eponychium. In most cases the distal fragment of bone is removed by sharp dissection, but if the palmar skin bridge is so small as to make the blood supply questionable, the chips are left in. Union rarely occurs, but this appears to offer no inconvenience. The epidermis of the distal wound edge is trimmed so that none of it overhangs. With non-absorbable suture material of about 000 size on a small curved cutting needle, 2 vertical mattress sutures are placed through the nail and proximal wound edge. Similar deep mattress sutures are placed in the soft tissues on either side to obtain perfect apposition and to close all dead space. A dry dressing and finger splint are applied over a sterile strip of cellophane, which prevents sticking. Redressings are infrequent, and the sutures are not removed until the tenth day. The remaining nail becomes completely detached within a few weeks, and the new nail grows out firmly attached at the root and to most of the peripheral nail bed.

JOHN L. LINDQUIST, M.D.

#### Le Quesne, L. P.: Bacteriology of Septic Fingers. *Brit. M. J.*, 1946, 1: 163.

A study was made of the primary organism and the secondary invaders in a consecutive series of septic lesions of the hand which required incision in an out-patient department. None was severe enough to warrant admission to the wards. The surgeon did

not wear a mask, and used ungloved hands. The dressings were changed by a student or nurse, using the fingers, and at times the nurses passed from case to case without washing their hands.

A swab was taken from the lesion at the time of making the incision, and further swabs, so far as possible, were taken at two-day intervals until the finger was healed.

In a series of 100 cases which were fully investigated, the staphylococcus aureus was isolated from 93 per cent of the cases, and *B. hemolytic streptococcus* from 5 per cent. Eighteen patients became secondarily infected (4 of them with two organisms) before healing occurred. Thus, on 22 occasions a secondarily infected organism was isolated, but of the 22 organisms, 14 were recovered on one occasion only. In none of the 4 doubly infected cases were both organisms isolated more than once. Therefore, in only 8 cases did secondary infection become established. In 3 cases the secondary invader was the hemolytic streptococcus, in 3 it was the staphylococcus aureus, and in the remaining 2 it was the staphylococcus albus.

The average time between incision and healing in cases which did not develop secondary infection was 11.12 days; in those developing such infection, 20.88 days. Because of the small number of cases studied, the author does not consider these figures significant.

The author suggests that the actual incidence of secondary infection may have been higher than the figures given because of the inability to distinguish one strain of staphylococcus aureus from another. He believes that this rate can be materially reduced by a rigid aseptic technique and the intelligent use of wound antiseptics. THEODORE B. MASSELL, M.D.

Altmeier, W. A.: Penicillin in Tetanus. *J. Am. M. Ass.*, 1946, 130: 67.

Tetanus, or lockjaw, is one of the most dreaded infectious complications of wounds. Its treatment is still unsatisfactory and the results uncertain, even though its etiology has been known for 60 years and its diagnosis is relatively easy. The failure of large doses of antitetanic serum to alter the course or lower the mortality once the disease has developed is disappointing. This is true particularly in cases in which the incubation period is less than 6 days. Firor states that the outlook of generalized tetanus is always grave, and the mortality rate is frequently determined before the patient is seen by the physician. In one group of cases, no form of therapy known at this time will prevent a fatal outcome, while in another group—cases seen during the prodromal period—the recovery depends on early diagnosis and adequate treatment. This is a report of the potential value of penicillin in the management of established tetanus.

The author during the past 23 months has treated 16 cases of established generalized tetanus. Eleven of the patients were under 10 years of age and the oldest was 32 years old. Eleven were males and 5 females. The portal of entry was usually so small

that it was frequently overlooked. In 2 cases the primary wound was unknown and never demonstrated. Five wounds were puncture wounds. Four were infected lacerations, 3 were abrasions, 1 was a plastic operative wound, and 1 a recurrent foot ulcer. Ten patients had wounds of the lower extremity: 2 had wounds on the face, and 2 had wounds on the hand. The incubation period was unknown in 3 cases, less than 5 days in another 3, from 6 to 10 days in 6, and from 11 to 15 days in the last 4 cases.

All patients received antitetanic serum, intravenously or intramuscularly, as soon as the diagnosis was made. The amount given varied from 20,000 to 390,000 units. Fourteen of the patients received 50,000 or more units, 10 received 100,000 or more, and 5 received 250,000 or more units. In 9 cases the primary wound was excised an hour after from 10,000 to 20,000 units of antitetanic serum were infiltrated into the surrounding area. The wounds were left open and packed with zinc calcium peroxide ointment. Thirteen of the patients received penicillin in dosages of 15,000 units every 3 hours. In 8 cases a total of 500,000 or more units were given, and in 3 cases from 1,000,000 to 1,500,000 units were given. It was intended to give all of the patients a total of 1,000,000 or more units of penicillin if they had lived long enough.

In this series there were 10 deaths, a mortality of 62.5 per cent. Nine of the 13 patients receiving penicillin died. All the patients with an incubation period of 5 days or less died, 4 of 6 with incubation periods of from 6 to 10 days died, and only 1 of 4 with incubation periods of from 11 to 15 days died. Two of the 3 with unknown incubation periods died. Their clinical courses suggested that their incubation period was 5 or 6 days or less. These observations bear out the relationship of high mortality rate and short incubation period.

The amount of antitoxin given did not seem to affect the survival rate. Four of 5 patients receiving 250,000 units or more died, 5 of 10 receiving 150,000 units or less died, and 4 of 6 receiving 75,000 units or less died. Only 1 case of typical serum sickness developed.

Clinical improvement in most established infections usually occurs in from 18 to 72 hours after the onset of treatment with penicillin. In these cases of tetanus treated with penicillin, no obvious beneficial results that could be attributed to the penicillin were noted except in 1 case which had a complicating pneumonia. Six of the 9 deaths following penicillin treatment occurred within 60 hours after admission and the beginning of treatment. These were due chiefly to respiratory arrest associated with toxemia, pulmonary edema, and hyperpyrexia.

The author then gives reports of 5 cases in 4 of which the patient recovered. The purpose of these reports was to illustrate the results of special interest. To control convulsions the author used phenobarbital sodium, paraldehyde, tribromethanol, and pentothal sodium.

In the author's experience, penicillin has not proved to be a lifesaving measure in treating tetanus as reported in the literature.

Tetanus is an infectious disease developing after a variable incubation period and caused by a potent water soluble toxin produced in a wound infected by clostridium tetani. The wound is usually small, probably because most large wounds have medical care and are given 1 or more injections of antitoxin routinely. There is no problem of local invasiveness or tissue destruction in these wounds as in other types of infections. Instead, it is the production, distribution, and fixation in susceptible tissues of extremely small quantities of a specific and powerful toxin. After a fatal dose of toxin has become fixed in the central nervous system, death is inevitable, as the antitetanic serum, even in extremely large doses, fails to affect the course of the disease. This is a sharp contrast to the effectiveness of only 1500 units as a prophylactic preventative at the time of injury.

Penicillin, although effective against clostridium tetani, has no known effect on its toxin. Therefore, the results of this series were not surprising. Complications such as pneumonia or secondary invasive wound infection during the course of tetanus are well treated by the use of penicillin.

The failure of penicillin to alter appreciably the course of established generalized tetanus re-emphasizes several important concepts: (1) the length of the incubation period is the most important single prognostic sign; (2) the essential primary cause of the disease is a bacterial toxin; and (3) successful management depends not on chemotherapy, but on early diagnosis during the prodromal period with immediate neutralization of the existing free toxin by serotherapy, removal of the source of toxin, control of the convulsive seizures, control of attacks of respiratory arrest, and the administration of general supportive measures.

ROBERT R. BIGELOW, M.D.

## ANESTHESIA

Mousel, L. H., Stubbs, D., and Kreiselman, J.: Anesthetic Complications and Their Management. *Anesthesiology*, 1946, 7: 69.

Anesthetic complications are essentially deviations from the normal physiology. The extent and the duration of these deviations will determine whether death occurs or whether the incident becomes a postoperative complication. Anoxia plays a most important part in these complications.

This report is a detailed study of 47 deaths under anesthesia occurring in the Washington area, with an incidence of from 1 in 300 cases to 1 in 8,000 cases. The range of variation was dependent upon the skill and training of the anesthetists involved. Most anesthetic deaths were caused by the improper selection of anesthetic agents, improper administration, improper replacement therapy, or failure to do efficient resuscitation.

The differential mortality was highly unfavorable to cyclopropane. In more than half of the cases in which death occurred during the administration of this agent, primary or at least very early cardiac failure was observed. Death occurred from 20 to 25 times as frequently in hospitals with the poorest types of anesthetic organization as in those institutions with highly trained specialized anesthetists. Nitrous oxide was considered a hazardous agent when even mild oxygen want was present, and primary and secondary saturation methods of administering gas were severely condemned. Reliance upon the suck and blow method of resuscitation and upon the so-called analeptic or respiratory stimulants was considered a serious mistake; nor has carbon dioxide a place in the treatment of asphyxia. Resuscitation with adequate pulmonary ventilation, assuring a tidal exchange of from 300 to 400 c.c., should be the objective, and should be accomplished by means of positive pressure inflation with oxygen, and the available anesthesia apparatus. Positive pressure of 20 mm. of mercury is almost always required to inflate the lungs of an adult.

Anesthesia should be placed in the hands of trained specialists, who would promote teaching and stimulate discussions of anesthesia problems.

The maintenance of a clear airway is essential. Patients subjected to spinal anesthesia must be watched as closely as those under general anesthesia. Most deaths on the operating table during major thoracic surgical procedures are the result of obstruction and acute anoxia, and not of vagovagal reflexes. Every anesthetist who attempts the responsibility of anesthesia in thoracic surgery should be an expert bronchoscopist. MARY KARP, M.D.

Lenahan, N. E., and Elliott, D.: Ether Convulsions. Discussion and Presentation of a Case. *Current Res. Anesth.*, 1946, 25: 31.

The so-called "ether convulsions" are not really due to ether. Several factors must be present at the same time and in certain ratio or proportion to produce them. The strength of the stimulus required to initiate the convulsions will depend on the potency of the predisposing conditions. It has been shown that from 20 to 30 per cent of carbon dioxide will induce convulsions in the anesthetized human subject. Pyrexia increases the response of the patient to carbon dioxide.

The factors which may cause or predispose toward convulsions are:

- A. Those present before anesthesia
  1. Specific factors associated with the nervous system
    - (a) Individual susceptibility—youth, convulsive diathesis
    - (b) Cerebral effects of the disease—edema, vascular disease, specific organisms, or neurotoxins
  2. Nonspecific factors affecting cerebral irritability which result secondarily from disease or toxemia

- (a) Calcium deficiency, ketosis, alkalosis, thymic syndrome, fever, renal insufficiency, imbalance of the autonomic nervous system, and abnormal metabolic states

**B. Those related to anesthesia or surgery**

1. Impurities in the anesthetic agent
2. Modification of the internal and/or external environment by drug action, technical method, or surgical procedures

- (a) Anoxia, faulty carbohydrate metabolism, temporary renal insufficiency, acid-base imbalance (metabolic and respiratory acidosis), abnormal distribution of body water and osmotically active ions, defective heat regulation, high environmental temperature, and reflexes from operative trauma

One case was reported in detail, that of a 3 year old child operated on for surgical repair of extrophy of the bladder, who developed generalized twitchings after 2 hours and 15 minutes of open ether anesthesia. She was treated with oxygen and 5 per cent glucose in normal saline solution given intravenously. She recovered uneventfully without any evidence of personality changes.

For the treatment of convulsions it was suggested that the anesthetic be withdrawn at once, and that oxygen be given. Calcium glucose should be administered intravenously. The heart should be supported by a stimulant and barbiturates should be given to overcome the convulsive seizure.

MARY KARP, M.D.

**Gill, R. C.: Curare; Misconceptions Regarding the Discovery and Development of the Present Form of the Drug. *Anesthesiology*, 1946, 7: 14.**

A brief historical resumé of curare included the following facts:

1. It was known and used by the Indians of South America as an arrow poison during and since pre-Columbian times.

2. Civilized nations learned of it as early as 1595 when Sir Walter Raleigh, after his voyage to the Orinoco, told of its use by the natives.

3. Watterson and Brodie in 1815 demonstrated that asphyxia was the cause of death in curare poisoning.

4. A few years later Claude Bernard, the French physiologist, discovered the physiological action of curare upon the neuromuscular junction.

The author points out that there are certain misconceptions constantly appearing in the literature which are related both to the background of curare and also to its current employments. An outstanding example of misinformation which appears in various publications is that curare is an unpredictable drug and that the "dosage is unreliable." The Federally accepted ampule curare, however, is unvarying, reliable, and predictable.

All types of curare, both primitive and evolved, have contained a complex of known botanical in-

gredients, and are not from any single species, genus, or even family of plants. It is not made from the bark of the strychnos group (loganiaceae family) alone, nor does the chondodendron species (Menispermaceae family) deserve a similar ethnobotanical "monopoly."

There are also errors relating to the geographical distribution of curare. For instance, a popular pharmaceutical index states: "Habit, Orinoco, South America, the arrow-poison of the Orinoco Indians." Factually, the Orinoco basin of South America is a far less productive source than other and larger regions of Amazonian drainage throughout northern and western South America.

A major misconception appearing in various well known publications is that the varieties of curare are designated by the kind of containers in which they reach commerce. The type of native container (dried gourd, bamboo tube, or small clay pot or jar) is in no way an indication of the kind of curare. It depends entirely upon which first comes to the hand of the Indian maker, and may vary from day to day.

Still other categories of scientific error and misconception continue to appear in the literature. These relate especially to the pharmacodynamics of the substance and its physiological actions. This is apparently the classical beginning of any new drug, and, fortunately, many of these errors seem about to disappear.

This interesting and informative article closes with a plea that curare be administered by medical anesthetists only. The administration of the drug and the handling of the curarized patient is as responsible "an incursion into that field legally defined as the 'practice of medicine' as is the administration of any anesthetic agent per se."

EDITH EASON, M.D.

**Harbroun, P., Beckert, F. E., and Hathaway, H. R.: Curare and Nitrous Oxide Anesthesia for Lengthy Operations. *Anesthesiology*, 1946, 7: 24**

Curare and nitrous oxide have been used for the past 7 months at the University of California for a number of lengthy surgical procedures.

Following ample medication, nitrous oxide and oxygen were administered until the patients were in first plane anesthesia. After a pharyngeal airway had been inserted, the anesthetist's ability to inflate the patient's lungs was tested. Curare (from 150 to 200 mgm.) was given intravenously, this dosage usually producing apnea. When muscular relaxation occurred an orotracheal tube with an inflatable cuff was inserted under direct vision. The nitrous oxide mixture was then administered through this tube by means of the carbon dioxide absorption technique, the patient being maintained in first plane anesthesia. Further amounts of curare were given as needed to produce the relaxation required at various stages of the operations. The patients reacted to lack of oxygen by muscular rigidity, or to excess carbon dioxide by increased respiratory efforts even though large doses of curare were used. The pa-

tient's lungs were adequately ventilated at all times, either by the patient himself or the anesthetist.

During the first of the series dilatation of the intestine was an embarrassing complication in a few instances. Morphine was administered for this condition and satisfactory constriction resulted. A comparison with patients who received other types of anesthesia was made. The curare group had fewer postoperative complications. Most of the patients had marked muscular weakness which persisted for several hours. This necessitated careful postoperative nursing with frequent change of position.

It was believed that this combination provided adequate relaxation for surgery, and at the same time did not endanger the patient's well being by long periods of deep anesthesia. The usual anesthetic techniques, when prolonged over a period of 4 hours or more, often produce signs of circulatory disturbance.

EDITH EASON, M.D.

Mayer, E. C., Jr., and Neff, W.: Further Experiences with Endotracheal Ether-Air for Intrathoracic Surgery. *Anesthesiology*, 1946, 7: 32.

A method is presented of using ether-air anesthesia with a simple apparatus for intrathoracic operations. The original intention was to provide a means whereby anesthesia and ventilation could be maintained while the chest was held open for long periods of time under emergency, and when the "to-and-fro" carbon dioxide technique apparatus was not available. Because of the satisfactory results obtained the method was continued in civilian work. This report includes 50 intrathoracic operations which were performed under this anesthesia technique.

Induction is usually accomplished with pentothal or nitrous oxide and ether. An oroendotracheal tube

is inserted under direct vision. This is connected directly to the Stanford vaporizer. When the thorax is open, ventilation of the lungs is accomplished by rhythmically and intermittently inflating them by the valve and bellows method. Respirations are controlled by inflating the patient's lungs from 15 to 20 times per minute at a pressure of 10 mm. of mercury. If positive pressure is not required when a fixed mediastinum prevents paradoxical respiration, and in pericardiectomies in which the approach is made directly into the anterior mediastinum, an improvised exhalation valve is inserted between the endotracheal tube and the vaporizer in order to reduce the dead space in the apparatus to a minimum.

Maintenance is usually conducted in midsecond plane anesthesia. There is a discussion of the management and maintenance of anesthesia, and the conclusion of anesthesia, with special emphasis on re-establishment of spontaneous respiration. Careful tracheobronchial suction is performed before removal of the endotracheal tube.

Supportive treatment includes replacements and drug therapy. Oxygen is given continuously after operation for from 24 to 48 hours.

Accidents included the mistaken connection of the Levine tube to an oxygen catheter and aspiration of vomitus.

A clinical study of the 50 cases is given in a detailed chart. The youngest patient operated on was 8 months old, and the oldest 75 years. The shortest operation took 50 minutes and the longest 7 hours and 50 minutes.

This method is presented as a possible technique of choice for intrathoracic operations even though the more elaborate equipment is available.

MARY KARP, M.D.

# PHYSICOCHEMICAL METHODS IN SURGERY

## ROENTGENOLOGY

Finland, M., Ritvo, M., Davidson, C. S., and Levenson, S. M.: Roentgenological Findings in the Lungs of Victims of the Coconut Grove Disaster. *Am. J. Roentg.*, 1946, 55: 1.

A correlation of the roentgen findings with the clinical manifestations in 87 cases is reported from the Boston City Hospital, Boston, Mass. There were roentgenographic changes in 71 of these cases; 51 per cent had comparable clinical and roentgenographic findings; 33 per cent had more extensive, and 5 per cent much more extensive, clinical than roentgen findings; while only 11 per cent had more extensive roentgen than clinical findings. No correlation was noted between the roentgenographic changes and the extent of the surface burns. There were 15 deaths. Only a few of the patients were roentgenographed before the first 36 hours.

The authors state that the roentgen findings in their group are very similar to those reported by Schatzki in the *Annals of Surgery*, (1943, 117: 841). (These findings were made at the Massachusetts General Hospital, Boston, Massachusetts.)

Most, if not all, of the visible roentgen findings are believed to be due to interference with aeration from partial or complete obstruction of the bronchi, especially the smaller ones. Atelectasis, patchy or diffuse, was present in all but 1 of the positive roentgenograms. In only 1 instance was a complete massive atelectasis observed. Mottling, coarse or fine, was the next most common finding. Early and in the more severe cases a diffuse military type of mottling of both lung fields was observed. In other cases mottling was limited to one or two lobes. Emphysema, patchy and diffuse, also occurred frequently. Roentgenograms made during expiration were advantageous in bringing out the findings.

Increased hilar markings were present in 62 of the 70 roentgenographic positive cases. In 50 per cent of these cases the findings were unilateral. Only 5 cases showed consolidation and this was mostly patchy in distribution. Pulmonary edema was not observed in any of the roentgenograms, nor was extensive pulmonary edema found at autopsy.

In general, the more extensive roentgen findings had cleared before the end of the first week. However, small areas of atelectasis and patches of emphysema with increase in the hilar shadows persisted longer in some of the cases. Follow up studies from 6 months to 2 years later on the patients who had moderate or extensive roentgenographic changes showed no abnormalities. R. B. LEWIS, M.D.

Hodes, P. J., and Keefer, G. P.: Hookworm Disease. *Am. J. Roentg.*, 1945, 54: 728.

The authors report on 125 cases of proved ankylostomiasis in American troops cared for at an

Army General Hospital in the Province of Assam, in India, during a period of over 2 years, 60 per cent of whom showed roentgen abnormalities of the small intestine. Both ankylostoma duodenale and necator americanus are found in Assam where the native population shows a high rate of infestation. Approximately 80 per cent of the troops concerned came from areas in the United States in which hookworm is not a public health hazard, and all men were in excellent health on arrival in the China-Burma-India theater. In 80 per cent of the cases the disease was believed to have been of less than 3 months duration, and in the remainder, not over 6 to 8 months. Sixty-five per cent of the patients had clinical evidence of "hookworm disease"; the remaining patients came to the hospital as battle casualties, or were suffering from other diseases, and the positive stools were an incidental finding.

The clinical histories were frequently classic. Often the patient dated the onset of "ground itch" to a time when he had been lying in a fox hole for several hours, and localized it to that part of the body exposed to mud or water. The pruritus and dermatitis lasted from 4 to 7 days, and within a period of from 1 to 2 weeks after its onset a dry cough began, which was followed in turn by gastrointestinal symptoms. The latter appeared from 6 to 25 weeks after exposure of the skin to the larva-infested soil, and were often ushered in by an acute attack of nausea, vomiting, abdominal pain, and diarrhea. Diffuse epigastric pain of a burning or cramping character, often made worse by food, was the outstanding complaint, and half the cases had diffuse upper abdominal tenderness. In contrast to the anemia described in chronic hookworm disease, the red blood count and hemoglobin estimates were normal in all but 3 cases. The white cell count averaged 15,000, but varied from below 10,000 to over 40,000; eosinophilia was usually marked, ranging from below 10 per cent up to 80 per cent. Patients showed no evidence of frank malnutrition; plasma proteins were not ascertained.

The patients were given, orally, 5 oz. of barium in 5 oz. of distilled water, and were examined fluoroscopically at once and every 30 to 45 minutes thereafter for about 3 hours, films being obtained at 30 to 60 minute intervals. Similar studies had been made on 10 healthy members of the Command on arrival in the war theater and again 16 months later, and all appeared normal.

The roentgen changes noted in the patients with hookworm were, in general, comparable in degree to the clinical severity of the disease, and consisted in tenderness of the upper small bowel on direct palpation of loops, luminal narrowing, rugal fold distortion manifested by thickening and constantly shifting irregularity of valvulae conniventes with widening of the valleys between them, accentuated peristalsis,

and occasional localized fleeting dilatation of various segments. The proximal jejunum was the region most frequently and markedly affected, although in the more severe cases the changes spread into third and fourth portions of the duodenum and into the distal jejunum; and in some instances there were even minor abnormalities of the proximal ileum, a distribution which tallies well with known sites of hookworm infestation.

About 20 per cent of the patients were examined in from 2 weeks to 6 months after treatment, and most of them showed improvement in or disappearance of the abnormal roentgen findings, but in some the findings remained little changed long after the patient appeared clinically well. The abnormality which persisted longest was the labile distortion of the rugal fold pattern.

The authors feel some hesitancy in ascribing an irregular fold distortion, able to undergo lightning-like shifts in thickness, height and direction, to actual thickening of the wall of the intestine, and suggest that these changes may be due, at least in part, to a damaged intramural nervous system, a possibility which would help to explain the long post-treatment persistence of labile fold distortion in some patients who had become clinically well.

LILIAN DONALDSON, M.D.

Graff, W. S., Scott, K. G., and Lawrence, J. H.: The Histological Effects of Radiophosphorus on Normal and Lymphomatous Mice. *Am. J. Roentlg.*, 1946, 55: 44.

Two series of experiments were performed by the authors. In the first, three-month and five-month mice of the "A" strain were made lymphomatous by the intravenous injection of  $1.2 \times 10^7$  lymphoma cells. Thirteen days following the inoculation some of the lymphomatous mice received 195.3 microcuries (beta ray standard) of  $P^{32}$  intravenously. (The lethal dose for mice of this size is about 70 microcuries.) A second series was made lymphomatous in a similar fashion, but received  $P^{32}$  7 days later in 4 doses of 54.5 microcuries each every 2 hours. Suitable controls were kept in both series. Blood studies included white and differential counts. Red cell and hemoglobin determinations were not done.

In both series the drop in the white count was greater in the leucemic animals than it was in the controls during the first 4 days. In the following 5 days the white count in series 1 approached a plateau, while in series 2 the drop continued. In the control animals the small lymphocyte was first most markedly affected. The mature granulocyte was relatively little affected. However, at the end of 14 days both the lymphocytes and granulocytes were diminished. Approximately the same results were observed in the lymphomatous series and the leucemic cells were also diminished for 9 days.  $P^{32}$  delays lymphomatous invasion of the liver, bone marrow, lymph nodes, and spleen.

An attempt was made with sublethal doses of  $P^{32}$  to obtain "cures" of lymphomatous mice. For these

experiments intraperitoneal suspensions of granulomatous cells were used. After demonstrable tumors were produced, varying amounts of  $P^{32}$  were given intraperitoneally over periods of from 9 to 16 days. Regressions were observed in 5 of 31 treated animals. The dosage was just sublethal. Further observations of these "cured" animals were not made because of a change in the activities of the laboratory in 1941.

The authors conclude by stating, "We must look for the control of this disease (leucemia) by some method other than irradiation." R. B. LEWIS, M.D.

Evans, T. C., and Quimby, E. H.: Studies of the Effects of Radioactive Sodium and of Roentgen Rays on Normal and Leucemic Mice. *Am. J. Roentlg.*, 1946, 55: 55.

It has been thought desirable in the administration of radioactive elements to use those substances which are preferentially absorbed by the tissue to be treated. For example, radioiodine for the thyroid, and radiophosphorus for bone, bone marrow, leucemic tissue, and any rapidly growing cells. The treatment of leucemia with radiophosphorus is still in the experimental stage. The results obtained have been about the same as those obtained by roentgen therapy.

It was thought that radiosodium, because of the generalized distribution in the body of sodium and the short half life (14.8 hours) of the radiosodium, might be advantageous in the treatment of leucemia. The effect should be due to the rather uniform irradiation of the entire body. Experiments were conducted to show the effect of radiosodium on normal and leucemic mice. A parallel series was done to show the effect of roentgen irradiation. In normal rats, doses of from 3,000 to 4,000 microcuries were fatal in 2 weeks. A temporary reduction in the leucocyte count was produced by a dose as low as 300 microcuries. With increase in the dosage the white blood count was lowered, the duration of the leucopenia was increased, and the survival time diminished. From 350 to 1,000 r. of roentgen rays given to normal rats, 70 per cent on the first day and 30 per cent the next, produced results similar to the radiosodium. From figures so obtained it was calculated that 10 microcuries per gram of body weight is equivalent to 100 r. in mice. In human beings it is estimated that the roentgen equivalent would be at least double.

Leucemic mice with enlarged lymph nodes (strain Ak) were treated with radiosodium (animals with counts below 30,000 were considered aleucemic). The enlarged nodes disappeared, at least temporarily, with doses so low as to barely affect the white count. Larger doses produced the effect more quickly.

Leucemic mice with adenopathy were treated with radiosodium. In general they showed more reduction in lymphocytes than did the control animals.

On the average, the difference in the elimination of radiosodium by the leucemic animals and by the



normal animals was found not to be statistically significant. Several of the leucemic animals were sacrificed at various intervals and various portions of their bodies analyzed for radioactivity. There was no considerable concentration of the radiosodium in any particular organ or tissue. R. B. Lewis, M.D.

**Strand, S.: On Keloids and Their Treatment.** *Acta radiol.*, Stockh., 1945, 26: 397.

A review of the recent literature on keloids and a study of the results of radium treatment in 117 cases is presented. The actual cause of keloid growth is still unknown, although individual, family, and racial predispositions are apparent. Tissue predisposition seems to be partly local and partly general and is somewhat limited in time. Keloid growths show no tendency to malignant degeneration, although in old scars with keloid nodes, cancer of the epidermis has been observed to develop without any evidence of causal connection between the cancer and the keloid. Multiple keloids may suggest multiple sarcomas, but the appearance of the keloid with its smooth, atrophic skin and characteristic branched spreading renders the diagnosis an easy matter.

Since the cause of keloids is unknown, preventive treatment cannot be given. If a keloid is removed surgically, a recurrence will practically always occur, and often will be larger than the original keloid. Radium treatment has proved to be more rapid and certain of producing a good result than roentgen treatment, and lends itself to a more accurate and limited application so that it has become the treatment of choice. Combined surgical and radiation therapy is rarely used, not only because the result is unsatisfactory, but also because radiation alone has given such good results. Where the keloid lies over a joint and impedes its function, a plastic operation followed by irradiation is indicated.

The technique used in this series of 117 cases covering a ten-year period employed a radium mold with a radium-skin distance of 0.7 cm. and a filter of 0.7-1.0 mm. platinum. Molds were adjusted to render about 560 r. in 24 hours, and treatment extended over a period of 3 to 4 days to give a total of about 1,410 to 2,060 r. An attempt has been made to adjust the treatment to the probable radiosensitivity of the individual keloid, the age of the patient, and of the keloid, its extension and elevation above the surrounding skin having been considered. Regression appears only after from 7 to 8 weeks, and continues during several months to a year. Repetition of treatment with a somewhat smaller dose has been carried out in 36 cases, and a third treatment has occasionally been given. In a few cases slight permanent radiation changes have appeared in the skin. The result of treatment has been estimated as follows:

Very satisfactory regression in 67 cases (57%); good regression in 38 cases (32%); some regression in 7 cases (6%); no regression in 1 case (1%); and unknown regression in 4 cases (4%).

The type of trauma causing the keloid did not seem to influence the sensitivity of the keloid to radium treatment. A study of the influence of the age of the keloid on the result of treatment indicated that all cases treated during the first 6 months responded favorably, and that during the first year no case showed a poor reaction to treatment. Later an increasing number of cases reacted less satisfactorily to treatment. A study of the influence of the patient's age on the response to treatment showed that below the age of 10, all patients reacted well, but in the age group of 10 to 20 years a few showed only some regression. The results for the group over 20 years seemed to be somewhat below the average. The influence of age of the patient on the result of treatment appeared to be of less importance than the age of the keloid. In no case has there been a recurrence of the keloid or a regression of the effect obtained by radium treatment.

JOHN L. LINDQVIST, M.D.

**Mustakallio, S.: The Possibilities of Roentgen Therapy in the Treatment of Cancer of the Breast** (Ueber die Möglichkeiten der Roentgen-therapie bei der Behandlung des Brustkrebses). *Acta radiol.*, Stockh., 1945, 26: 503.

This article seems to be an attempt to answer the contentions of Pack and Livingston, who in their book (Treatment of Cancer and Allied Diseases. New York: Paul B. Hoeber, 1940) have collected numerous statistics tending to show that roentgen treatment is of doubtful value as an adjunct to radical surgery in mammary carcinoma, for when all cases of operable breast cancer treated by radical amputation are considered, the 5 year cures amount to about 40 per cent, whether or not the operation be preceded or followed by roentgen irradiation.

The author does not attempt to confute these figures; as a matter of fact in his material, including all patients undergoing radical amputation of the mammary gland for carcinoma combined with roentgen therapy, the figure for 5 year cures was 38 per cent. However, it is obvious that the operation of radical amputation of the breast is not only a mutilating procedure accompanied by psychic trauma; it causes the development of elephantiasis (temporary in 15 to 20 per cent, and permanent in 10 per cent of the patients) and the loss of earning capacity, and is of such tremendous scope that it is bound to weaken the patient generally, and the author maintains that this will have a bearing on the course of the disease itself.

He also maintains—and adduces authorities to support his contention—that there is a defense mechanism within the body which resists the growth and spread of the malignant process. For instance, of the 194 deaths within 5 years in the author's total material of 384 breast cancers in the years 1936 to 1945, almost all of them were due to distant metastases. In the cases of amputation the dissemination of the cancer cells, from which these distant metastases later developed, must have occurred at varying

periods prior to the operation itself and the cells must have lain dormant and unable to grow until some incident—perhaps the breast amputation—had lowered bodily resistance to the invading new growth. At least some sort of mechanism has been shown in the transplantations of tumor in the animal, in which relatively enormous numbers of cancer cells (450,000) must be introduced in order to start a growth, and there is other evidence, even in the author's material, that such a mechanism of resistance might exist, for instance, in the patients who developed a generalized carcinosis terminally. New metastasis would appear at times in the skin, as though the debilitating effects of the deep process would allow the previously dormant cell nests in the skin to start growing.

A further indication of the presence of some defense mechanism is seen in the results with roentgen therapy in the inoperable patients who were sent in for irradiation. In these the prognosis as regards life was not good; nevertheless, under the intense irradiation treatment as administered by the author, some of these 92 patients were still alive and free of symptoms from 3 to 5 years after initiation of the treatment. In the author's opinion this indicates that the resistance forces of the body toward the metastases at a distance, which must surely have been present previously, were increased by roentgen therapy to such an extent that the patients were free from signs of activity of their disease during this time.

However, the strongest case against radical amputation of the breast as the sole operation of choice when the tumor is still operable seems to be the 23 relatively early cases in the author's material in which a local excision was all that was done before the patient was turned over to the author for irradiation treatment. A large table, covering several pages, shows the particulars of each one of the 13 patients who were under treatment and observation for at least 3 years. It shows that the dimensions of the tumors varied from fist size to sizes so small that the new growth was palpable with the fingers; it shows that 8 of the 13 women had received intensive preoperative roentgen treatment, and that in some of these the tumor had become much reduced in size; in 1 case all living cancer cells had disappeared. Of course, the author does not contend that in a certain percentage of cases, even with simple extirpation of the tumor combined with roentgen treatment, metastases will not develop; however, it has appeared to him thus far that the percentage of metastases is at least not any greater than in the cases treated by radical operation.

Therefore, in the very early cases of breast cancer which are treated by local extirpation of the tumor combined with preoperative irradiation good results can be obtained, while, on the other hand, a radical operation cannot prevent the development of metastases. In 20 per cent of the author's material, in which the cause of death was known to the author, metastasis could not be determined when irradiation

treatments were started. Ninety per cent of the patients in whom such metastases could be determined died of metastasis at a distance despite radical operation. The author therefore believes that since radical amputation of the breast is an already pretty much perfected method, of which the possibilities have been fairly well exhausted, the profession should turn cautiously toward a more conservative type of therapy consisting of tumor extirpation combined with intense irradiation treatments.

JOHN W. BRENNAN, M.D.

## MISCELLANEOUS

Thoren, S.: Electroendotherapy as an Adjuvant to Radiotherapy in Uterine Cancer. *Acta radiol., Stockh.*, 1945, 26: 249.

From July, 1928 to August, 1938, inclusive, electrosurgery (electroendotherapy) was used in the Radium Hemmet of Stockholm as an adjunct to irradiation in the treatment of uterine cancer in 85 cases. Of these, 82 were carcinoma of the cervix and 3 carcinoma of the corpus uteri. Fifty-five patients with carcinoma of the cervix underwent electrosurgery in the last 20 months of this period. Electroendotherapy was used in 8 cases of cervical carcinoma for hemostasis only. Thirteen patients had extensive involvement of the parametrium, and of the pelvic and abdominal walls when first seen and were considered hopeless. The remaining 61 patients with carcinoma of the cervix uteri were treated with radium and x-rays according to the Stockholm method, followed by electrosurgery in 55 cases within the succeeding 2 years and in 6 cases after more than 2 years.

The primary carcinoma was histologically identified in all cases, and the metastases, recurrences, and remnant tumors in 37 cases. The results were as shown in Table I.

The main indications for electrosurgery were: (A) in cancer of the corpus: vaginal metastases in all 3 cases; (B) in cancer of the cervix: (1) incomplete disappearance of the tumor, (2) local recurrence of the tumor, and (3) radium necroses and cases in which the preoperative distinction between tumor and radium necrosis could not be made. Other indications were pelvic metastases, cases which ordinarily would have been subjected to hysterectomy, inoperable cases, and poor operative risks.

The preoperative diagnoses roughly grouped are shown in Table II.

Eighteen case histories of carcinoma of the cervix and 3 of carcinoma of the corpus are presented; all of these cases were treated by irradiation and electrosurgery. Two techniques were used:

1. Bipolar endotherapy with two large inactive electrodes applied to the patient's back and arm, and a small plate or ball shaped active electrode pressed into the tissue to be coagulated. Spraying of the field with cold water is necessary in order to prevent loss of tissue conductivity due to superficial coagulation.

TABLE I.—SIXTY-ONE CASES OF CANCER OF THE COLLUM TREATED WITH EE FOLLOWING IRRADIATION

Type of case	Number of patients	Alive without evidence of the disease 4 years after EE operation	Died of cancer		Died of intercurrent disease. No cancer at autopsy
			Local recurrence	Metastases but no cancer in the treated area	
Superficial focus	35	13	14	5	3
Deep focus	7	0	7	0	0
Deep focus and additional involvement of parametrium	11	3	8	0	0
Metastases in the lower vagina	8	1	4	3	0

TABLE II.—PREOPERATIVE DIAGNOSIS

Clinical interpretation of the cases previous to EE	No of patients	Alive without evidence of the disease more than 4 years after EE operation	Died of cancer		Died of intercurrent disease. No cancer at autopsy
			Local recurrence	Metastases, no cancer in the treated area	
Interpreted as cancer	48	11	28	7	1
Uncertain whether cancer or radium necrosis	10	5	4	0	1
Interpreted as radium necrosis	3	1	2	0	0

2. Fulguration; with this method the tissue around the electrode is charred and becomes non-conductive very rapidly. This prevents deep coagulation, which is a safety factor. The coagulated tissue is removed by curettage, the fulguration is started anew, and the process is repeated until the desired depth is reached

The complications due to these procedures were: rectovaginal fistulas in 2 cases, and peritonitis due to rupture of a pyosalpinx in 1 case.

In conclusion, the author states that electro-surgery is a valuable adjunct to the irradiation therapy of uterine cancer.

GERHART S. SCHWARTZ, M.D

## MISCELLANEOUS

### CLINICAL ENTITIES—GENERAL PHYSIOLOGICAL CONDITIONS

Clark, W. E. LeG.: *The Contribution of Anatomy to the War*. *Brit. M. J.*, 1946, 1: 39.

This report is a short survey of some of the contributions of anatomy to war problems. In the Department of Anatomy at Oxford University alone, apart from the articles of which publication was not prevented by security regulations, the number of confidential scientific reports and memoranda prepared during the recent war by the staff amounted to 104.

In the field of traumatic surgery a great deal of work on fundamental processes of tissue repair was carried out which has been of value in research into problems of nerve regeneration, of burns and their treatment, of skin grafting, of vascular supply in the muscles, and of muscle regeneration. Much of the results of this work has been published.

Studies were made on the effects of high velocity missiles of small size, and of blast. A standardized casualty rate was calculated indirectly for different types of weapons by reference to (1) the relative vulnerability of different parts of the body, (2) the striking velocity of missiles necessary to produce incapacitating wounds, (3) the mean projected vulnerable area of the body, and (4) data regarding the fragmentation of explosive projectiles and the velocity of fragments at varying distances.

The purpose of another type of research could be defined as "fitting the machine to the man." This work required an extensive anthropometric survey of Service personnel in order to get adequate information on body measurements and their range of variation, as well as the amplitude of movement of those joints of the body which are specifically used in the operation of machines of different types. In some cases an assessment of the force which can be exerted by the operator at various phases of movement was required. From the data of these investigations a machine could be designed that would fit the man and enable him to work efficiently.

It is suggested that the type of research organizations developed during the war should be continued during peace for the solution of peacetime problems.

JOHN L. LINDBQUIST, M.D.

Wilson, T. E.: Plasma Protein Estimations in Battle Casualties. *Med. J. Australia*, 1946, 1: 153.

A group of 13 severe battle casualties are reported. In these cases serial plasma protein determinations were made by means of the falling drop method. The results were tabulated in some detail and hypoproteinemia was demonstrated. The lowest value reported was 4.45 gm. per cent.

The value of this test in discovering cases of concealed hemorrhage and as a guide in the treat-

ment of severe trauma is discussed. Its use in other conditions such as burns, intestinal obstruction, and peritonitis is mentioned.

The replacement of blood volume, fluids, and proteins is discussed. THOMAS C. DOUGLASS, M.D.

Knisely, M. H., Elliot, T. S., and Bloch, E. H.: Sludged Blood in Traumatic Shock. Microscopic Observations of the Precipitation and Agglutination of Blood Flowing through Vessels in Crushed Tissues. *Arch. Surg.*, 1945, 51: 220.

The authors state that this article is the first of a series describing some of their studies of the pathological circulatory physiology of animals and men, preceding and during traumatic shock. They had two purposes in writing this article: (1) to introduce this series of studies on traumatic shock and relate them to other work from their laboratories, and (2) to describe the initiation of some microscopically visible changes in the physical consistency of the circulating blood which are caused by mechanical injuries to the tissues (cutting or crushing injuries), but which have not yet been found to be caused by hemorrhage alone.

In addition to the studies of the changes in the blood, vessel walls, and circulation, preceding and during traumatic shock, which have been introduced by this article, the authors are carrying out a larger series of studies of normal and pathological circulatory physiology. There is the microscopic study of:

1. The circulation in a number of tissues and organs of laboratory animals under the most nearly normal conditions which have been attained experimentally.

2. The mechanical consistency of the circulating blood.

3. The circulatory physiology of normal macaque rhesus monkeys and of monkeys infected with plasmodium knowlesi malaria.

4. The reactions of various parts of the vascular system during and following hemorrhage initiated with a minimum amount of mechanical trauma to animals.

5. The reactions of the blood and vascular system, and the changes in the circulation following mechanical trauma made with a minimum amount of hemorrhage from animals.

The methods used for studying the blood and small vessels with microscopes are described in detail. The discussion of the various controls necessary in this kind of study is presented at length, and the description of microscopic experiments with mechanical trauma on the omentum of a monkey is given, as well as descriptions of experimental crushing of mouse striated muscle.

For distribution of emphasis the authors present a summary and conclusions divided into sections

dealing (1) with controls, (2) with the methods, and (3) with the results of crushing injuries.

They note that after a crushing injury to monkey omentum, smooth muscle of mouse intestine, or striated muscle of a mouse, three zones may be distinguished: (a) a thrombosed zone, (b) a partially crushed or sludging zone, and (c) a zone which is injured so little that the blood flowing through it undergoes no detectable change.

In studying the possible initiating factors of traumatic shock, the following observations were made in these tissues: crushing plus flow through a vessel in the crushed area yields a stream of sludge into the general circulation; crushing plus thrombosis of a crushed vessel yields no sludge to the venous system, and flow without crush yields no sludge.

Thus, after trauma, local crush plus flow through a vessel in the crushed area are both necessary and, together, sufficient to yield a flow of sludged blood into the general circulation. After crush, precipitates can form around or between the moving blood cells in less than a second, while the blood is moving less than a millimeter.

It seems reasonable to suspect that the sludge initiators substances might be related to the substance capable of initiating blood clotting. If this is true, then many tissues and organs of vertebrates should release such substances when they are injured. At no time can sludged blood pass into the venous system faster than the flow through the crushed tissue.

For a time after the crush, the rate at which sludge is poured into the venous system can be as fast as the rate of flow through an open vessel in the crushed area. Retrogradation of an area can reinstate sludge formation in blood flowing through the area. This sludge can be formed in an area from which or into which there is no hemorrhage and but little loss of plasma through injured vessel walls. This sludge is also formed in the partially crushed regions of areas injured severely enough to cause local transudation of plasma, diapedesis of the red cells, and hemorrhages through the walls of the injured local vessels.

When first formed, some of the masses have sufficient internal rigidity to bulge the walls of the vessel through which they are being forced; if not changed, such masses would resist passage through the capillaries.

When first formed, the outer surface of the precipitated material is sticky to itself; hence, if not changed, such masses must, whenever they touch each other, tend to stick together and form larger masses.

The outer surface of the red cell masses formed in the blood flowing through crushed tissues is not visibly different in appearance or in behavior from the coated red cell masses formed in monkeys with plasmodium knowlesi malaria.

Hence, the precipitated coating with red cells which is formed in the blood flowing through crushed tissues may be ingestible by phagocytes of the

spleen, bone marrow, and liver. In monkeys with malaria, this mechanism destroys blood rapidly. During periods when the rates of production of sludge are faster than the rates of removal or resolution of the sludge, sludged blood should accumulate throughout the vascular system. If one injury or a group or a series of injuries were large enough and the flow through their sludging zones fast enough, all the circulating blood should change to a thick, mucklike sludge.

HERBERT F. THURSTON, M.D.

Tagnon, H. J., Levenson, S. M., Davidson, C. S., and Taylor, F. H. L.: The Occurrence of Fibrinolysis in Shock, with Observations on the Prothrombin Time and the Plasma Fibrinogen during Hemorrhagic Shock. *Am. J. M. Sci.*, 1946, 211: 88.

Fibrinolysis has been observed previously in patients who died in peripheral vascular failure. This was noted especially in the Soviet Union by Yudin and his colleagues following the use of cadaveric blood for transfusion.

Studies of fibrinolytic activity were made in 22 patients in a state of peripheral vascular failure. The results are shown in the table below.

Three of the patients with thermal burns were treated effectively for shock. With recovery from that state the fibrinolysis disappeared.

Observations were also made on dogs with shock experimentally induced by bleeding. In 13 animals one large bleeding was used to produce hypotension of from 40 to 50 mm. of mercury and this level was maintained by repeated small bleedings. No anticoagulant was used. In a series of 6 dogs, death by exsanguination was produced in from 5 to 18 minutes. Blood samples in the latter series were taken every 1 or 2 minutes. Determinations of the prothrombin time and the plasma fibrinogen level were made in some animals as well as observations on fibrinolysis.

Of the 13 dogs in sustained shock (first series) 5 showed fibrinolysis. In no instance did the latter phenomenon occur during the first 2 hours following the onset of shock. Simultaneous samples of venous and arterial blood were obtained from 1 animal. Fibrinolysis appeared sooner in the venous sample. All but 1 of the dogs that failed to exhibit fibrinolysis died during the fourth hour of shock. Measurements of the prothrombin time were made simulta-

TABLE I.—FIBRINOLYSIS IN SHOCK (IN MAN)

	No. of Cases	Fibrinolysis
Burns Shock	3	3
No shock	3	0
Hemorrhagic shock	4	4
Traumatic injury Shock	1	0
No shock	4	0
"Medical shock"	7	1

taneously with the fibrinolysis observations on 8 animals. All of the dogs that survived over 2 hours showed a progressive diminution of the prothrombin in the blood, although 4 of them had demonstrated no fibrinolysis. The plasma fibrinogen level was measured in 5 of these animals and was found to fall along with the prothrombin.

Of the series of 6 dogs that were bled continuously, 3 showed terminal fibrinolysis but there was no significant change in the prothrombin and fibrinogen levels.

The authors attribute the phenomenon of fibrinolysis in shock to anoxemia. It is further suggested that this effect may be a manifestation of the presence of a circulating proteolytic enzyme from cellular elements of damaged tissue. The probability of the latter hypothesis is consistent with the finding in 1 animal that fibrinolytic activity was present in the venous blood some time before it appeared in the arterial blood.

An explanation of the fall in prothrombin and fibrinogen is not offered. However, it is suggested that the usefulness and indications of blood and plasma substitutes devoid of prothrombin and fibrinogen should be reconsidered if shock in human beings results in the reduction of the level of these substances in the blood.

THEODORE B. MASSELL, M.D.

Page, I. H.: Vascular Mechanisms of Terminal Shock. *Cleveland Clin. O.*, 1946, 13: 1.

In terminal shock the survival of the shocked patient depends on the survival of the vital tissues, which in turn depends on the volume and rate of blood flow in the tissues. Observation of a patient with acute arsenic poisoning and extreme hypotension led to the belief that the level of arterial pressure was not the major determinant of tissue perfusion. In previously reported experimental work the author had observed constriction of the main visceral vessels and small peripheral vessels in the late stages of experimental shock. Vasoconstriction was attributed to the presence of an ultrafilterable substance in the plasma from the sites of tissue injury. With continued shock the vessels become refractory to chemical stimulation, and the terminal stage is heralded by cardiac and vascular dilatation.

On the basis of his experimental observations and confirmatory data from other sources, the author advocates intra-arterial transfusion for the treatment of late shock. An 18 gauge needle is inserted into the radial or femoral artery with the point toward the heart and blood is administered freely from a reservoir set at 50 mm. of mercury. When equilibrium is reached at this pressure so that the inflow ceases, the positive pressure is increased to 70 mm. of mercury, and so on, by increments, until a final equilibrium of arterial and reservoir pressure is reached at approximately 100 mm. of mercury. This point should be reached in a few minutes.

If it is believed that the vascular refractoriness appeared because of a long period of deep shock, it

sometimes seems desirable to give a small amount (200 mgm.) of 2-amino heptane into the infusion tubing just as the blood starts to flow in. The drug is used because it tends to constrict the heart and, as has been shown, cardiac dilatation is a serious danger in this stage of shock. The drug has no use apart from the coincident infusion of blood or plasma, and repeated doses are increasingly ineffective. It has not been shown to have value in the treatment of terminal shock either alone or in conjunction with intravenous transfusion.

The intra-arterial infusion method has several advantages. These seem to be: (1) the delivery of blood into the aorta perfuses the coronary vessels, and thereby relieves myocardial ischemia, and since myocardial ischemia probably underlies the cardiac dilatation and insufficiency, the heart is rapidly placed in a state in which it can pump the infused blood to other areas; (2) when, before the infusion, the patient may have been apneic, at its start he will take a deep breath, as if the arterial filling had rapidly extended to the vital medullary centers; (3) in contrast to intravenous transfusion, the blood pressure is rapidly restored, and the volume of blood infused is determined, not by time consuming analysis or by guess, but by the actual capacity of the vascular tree; and (4) a subsidiary advantage lies in the fact that latent bleeding, from the spleen, liver, or kidney, which causes arterial pressure to fall off rapidly, is detectable within minutes rather than hours.

THEODORE B. MASSELL, M.D.

Rosenthal, S. M., and Tabor, H.: Electrolyte Changes and Chemotherapy in Experimental Burn, Traumatic Shock, and Hemorrhage. *Arch. Surg.*, 1945, 51: 244.

Simplified and standardized methods of producing shock in laboratory animals have been utilized to effect shock by burn, trauma, and hemorrhage in large numbers of mice. Traumatic shock was produced by the application of rubber band tourniquets to the hind legs. Two hours later an increase of fluid in the injured part, equivalent to 3 per cent of the body weight, was demonstrated. There was an increase in the local quantity of sodium above that contained in the edema fluid, equivalent to the entire amount of sodium contained in the circulating blood or to one-fourth of the sodium in the extracellular fluid of the body, and a practically equivalent decrease in the local potassium; this suggested an interchange of the ions. Studies of the urinary excretion by animals which survived shock through the administration of isotonic sodium chloride solution showed a marked retention of the sodium during the first 48 hours, equivalent in terms of the isotonic solution to 20 per cent of the animal's body weight. In the same period the potassium excretion was over that of the control animals by more than twice the amount of potassium calculated to have been liberated from the traumatized area, which indicated some release of potassium from nontraumatized areas. That the potassium might be toxic was indi-

cated by the large amounts released. This hypothesis was supported by experiments in which potassium was administered to shocked and normal animals.

The experiments indicate that in shock there is dehydration of the sodium-containing extracellular fluid, the major portion of which must occur in the tissues. The tissue deficit must be corrected before a normal plasma volume can be maintained; and this requires the administration of large quantities of isotonic sodium solution. From the therapeutic standpoint, it is significant that after a fatal degree of burn, trauma, or hemorrhage the majority of animals survived if given an amount of isotonic solution of sodium salt equivalent to from 10 to 15 per cent of their body weights. Since all sodium salts tested gave the same result and other cations gave negative results, it is apparent that the beneficial effects depend on the sodium ion. In burn and traumatic shock the use of protein-free ultrafiltrate of serum indicated that the beneficial effect of serum was attributable to its electrolyte content. In hemorrhagic shock, however, whole blood or erythrocytes in isotonic sodium chloride gave better results than plasma or saline solution alone.

The authors emphasize the significance of fluid disturbances and specific electrolyte changes in the acute shock following burns, trauma, and hemorrhage. They advocate the administration of quantities of isotonic solutions of sodium salts equivalent to at least 10 per cent of the body weight during the first 24 hours and point out that such therapy is more important to survival than the administration of plasma proteins. The fact that such therapy may be given orally (one part of lactate solution to two of chloride for a palatable mixture) is of great practical importance. B. F. LOUNSBURY, M.D.

**Crossman, L. W., and Allen, F. M.: Shock and Refrigeration. *J. Am. M. Ass.*, 1946, 130: 185.**

The demonstration of the inhibition of shock by reduced temperature was the first break in the universal tradition of warming shocked patients or their injured parts. Both clinical and experimental observations now leave no doubt that the difference between high and low environmental or bodily temperatures can amount to the difference between life and death in shock.

The more radical refrigeration which can be applied to local regions has correspondingly powerful effects. It prevents pain and primary shock and thus can serve for operative anesthesia. Also, by temporarily arresting all local metabolism, secondary shock and all local reactions to injury are inhibited. Besides the reduction of the physical factor of exudation, there is halting of production and great diminution of absorption of all kinds of toxins, so that hypothermia is the only known treatment which can affect the toxic factor in shock. There is agreement in recent literature that these effects are sufficient to save life in suitable cases. In addition, the reduced temperature can augment the benefits and

remedy the defects of the pressure treatment. Alone or combined with pressure, the cooling may range from near freezing in a crisis to the moderate degree obtainable by the wetting of thin dressings with water or alcohol, or exposure to cool air or a fan current. There is no excuse for elevation of the temperature in any shock treatment, and the need for cooling is increased by hot weather or a febrile complication.

The first clinical use for operative anesthesia was described in 1937, but it did not receive a large scale trial until 1941. The reduction of mortality in poor risk amputation cases by the avoidance of shock and various complications has become familiar through many independent reports. A few misapprehensions may be corrected by the reminder that the prevention of hypotension by special measures during spinal or other anesthesia has no influence on secondary shock, and that a shockless thigh amputation is impossible except under refrigeration. The ability of patients to enjoy full meals immediately before and after refrigeration operations is a small illustration of the difference from other methods. The exceptionally low mortality statistics of a few operators are *prima facie* proof that their class of patients were strong enough to withstand shock, and if they find reasons for preferring other anesthetics under these conditions, at least the saving of many formerly "inoperable" cases by refrigeration is now established by sufficient testimony.

Many forms of trauma can be benefited by the unique power of cold to control simultaneously pain, shock, exudation, infection, necrosis, and the formation and absorption of toxins. Refrigeration is especially important in the treatment of burns and military surgery in general.

A form of benefit which no one has questioned is the checking of intoxication in infected gangrene. When operation must be deferred because of a moribund condition, refusal of consent, or other causes, the simple packing of such an arteriosclerotic limb in ice often transforms the condition dramatically within 1 or 2 days.

Closely related to this is the control of dangerous infections in limbs without arteriosclerosis. There is evidence that the chilling extends deeply enough to produce considerable effects on bacterial activity and toxic absorption, even without a tourniquet. The latter should be used in cases of expected amputation but not otherwise, and it should remain in place until after the amputation. The ice pack should extend all the way to the axilla or groin, to control invisible extensions of infection above the tourniquet. With or without a tourniquet, the purpose is usually a temporary arrest of an overwhelming invasion, affording an interval for building up resistance or for serum or other treatment.

Embolism of the limb arteries has been treated with refrigeration only at a late stage in order to avert impending gangrene when weakness, or cardiac or other complications contraindicated immediate operation. Such a respite for as long as several

weeks has sometimes been followed by successful amputation. There is evidence that cooling is equally effective in early embolism. The use in fresh embolism is closely paralleled by the experiences with trauma, often including thrombosis. The usual purpose is the immediate control of pain and shock and the prevention of infection and necrosis for a long enough time to permit of other needed treatments and recovery.

Amputated parts, on the other hand, can be preserved, as has long been known, in an ice box. Examples of severed fingers comparable to the severed legs of experimental animals have been shown. Preservation of such parts with refrigeration has become routine in England.

In the treatment of arterial spasm, refrigeration is rewarded with much success. Nerve blocking with procaine does not always release the supposed reflex. Since refrigeration anesthetizes both nerves and protoplasm, it should theoretically release arterial spasm even when procaine fails. Evidence of this is the noticeably full blood flow in stumps after ordinary amputations under refrigeration.

The fact that the necrosis following severe freezing is due to secondary thrombosis rather than a direct killing effect of cold is the basis of a new treatment in which the administration of heparin for 3 to 4 days brings about healing instead of sloughing.

The unique simultaneous inhibition of pain, shock, exudation, infection, necrosis, and intoxication recommends refrigeration as an ideal treatment for burns; it can also be combined with other treatments as desired. Plunging the involved part into cold water or applying ice not only gives the quickest emergency relief of pain and inflammation but also reacts most favorably on the later course.

STEPHEN A. ZIEMAN, M.D.

Freeman, S., Rhoads, P. S., and Yeager, L. B.: Toxic Manifestations Associated with Ertron Ingestion. *J. Am. M. Ass.*, 1946, 130: 197.

In 1 adult patient receiving doses of ertron, such as are used currently in the treatment of arthritis, renal insufficiency occurred, and in a child with rheumatoid arthritis who was given 100,000 units of ertron daily, a decreased calcium retention and an increased urinary excretion of calcium were noted. These observations further support the conclusion that large doses of vitamin D from any source are potentially toxic. This toxicity can be explained as being due to the effect on the calcium and phosphorus metabolism and on kidney function.

WALTER H. NADLER, M.D.

Brown, A.: The Ehlers-Danlos Syndrome. A Description of 3 Cases. *Glasgow M. J.*, 1946, 27: 7.

The syndrome characterized by hyperelasticity of the skin, hyperextensibility of the joints, and a hemorrhagic tendency was first described by Ehlers in 1899. Other men have since described it.

The skin in a typical case is fine and soft, like velvet. It may tear readily, and accidental injuries

or surgical incisions heal slowly and leave a papyraceous scar which is not adherent to the subadjacent tissues. Approximation of the edges of a wound is difficult to maintain because the sutures tend to cut out and a low grade infection often supervenes. Elasticity of the skin may be very much increased, especially on the upper part of the trunk, where the skin may be drawn out several inches from its original position, and it will return at once on being released. This hyperelasticity of the skin is to be differentiated from an unusually lax skin (cutis laxa), a second variety of loose skin. Hyperextensibility of the joints is a very variable and inconstant feature. It often involves the joints and it may be absent. Friability of the skin and a hemorrhagic tendency are not necessarily related features.

There is frequently a tendency for hematomas to develop after a trivial injury. Bleeding may or may not occur after an incision. Small nodules have been found in the subcutaneous tissue. At first glance, these seem to be composed of fatty cells surrounded by a dense fibrous capsule. Calcification may occur in them. The Ehlers-Danlos syndrome may show a hereditary element. The author gives 3 case reports with complete examination and the laboratory findings. He arrives at the following conclusions:

Two patients, a mother and daughter, showed hyperelasticity of the skin, hyperextensibility of the joints, and a hemorrhagic tendency. In four generations of their family, 19 of the 47 individuals were affected by a similar or closely related condition.

Among the affected members of this family, hyperelasticity was a minimal feature in the earlier, and a dominant feature in the later, generations. An unusual friability of the skin showed an inverse relationship.

A third case is described in which increased friability of the skin and subcutaneous tissues was associated with an almost entire loss of the body hair, a slight hyperelasticity of the skin, and a hemorrhagic tendency. These features developed when the patient was 53 years of age. There was no evidence of a hereditary element.

PAUL MERRELL, M.D.

Spelman, C. R.: The Protection of Feet Immersed in Cold Water. *U.S. Nav. M. Bull.*, 1946, 46: 169.

In feet maintained at temperatures below 12 or 14°C., hyperemia, swelling, and pain occurred quickly, but serious injury (immersion foot) did not occur rapidly at temperatures near the upper limit of this range. Feet maintained at an average temperature of 12°C. for 30 hours recovered quickly. By means of a thin layer (6.5 mm.) of good insulating material (with heat conductivity of 0.00015 cal./°C./cm./cm.<sup>2</sup>/sec.), feet immersed in ice water (0.5°C.) were maintained at a temperature of from 12 to 14°C., at which temperature immersion foot does not occur rapidly. However, very large quantities of insulation were needed to keep feet above the temperature at which immersion foot may occur if exposure was sufficiently prolonged (observations



were made on subjects who were sitting in the cold with legs dependent). When the body was kept warm, the feet, encased in the insulation described and immersed in ice water, remained much of the time above the temperature at which injury by cold occurs. Petrolatum did not appear to afford any great protection to feet immersed in cold water. Exercising the feet seemed of value and should be of aid in preventing immersion foot.

WALTER H. NADLER, M.D.

**Barnett: Progress in Our Knowledge of Hydatid Disease. *N. Zealand M. J.*, 1945, 44: 304.**

Of 1,828 records in the Hydatid Registry of the Royal Australasian College of Surgeons, 1,152 (65%) are grouped as cases of liver disease and secondary disease of the peritoneum and 451 (24%) as cases of lung disease. Liver disease and secondary peritoneal cysts of the abdomen and pelvis are classed under one heading because true primary peritoneal cysts are definitely rarities, less than 1 per cent, although many have been erroneously recorded as primary cases because the original primary location in the liver had not been recognized. It is remarkable how frequently rupture of a liver cyst into the peritoneal cavity escapes notice until multiple secondary cysts, or (as a surgical curiosity) a single heterotopic primary cyst, make themselves manifest many years after. The percentage of lung cysts in the Australasian Registry is 24 per cent, whereas the generally accepted figure in overseas literature is 12 per cent.

A study of the Registry gives proof also that the vast majority of primary cysts originate in childhood. It may be accepted as a fact that a juvenile primary cyst in an adult is of very rare occurrence, and that the aphorism of Deve, Dew, and others, that a hydatid cyst is nearly as old as its host, holds true.

It is the author's personal impression also that only a small proportion of children are susceptible to hydatid infection; otherwise, under conditions prevalent in hydatid countries the human incidence would be far higher than it is.

In a hydatid country like New Zealand one should remember that biliary colic and jaundice may be due to the opening of a hydatid cyst into the bile ducts. The usual laboratory tests should be supplemented in all suspicious cases by a careful examination of the feces for cyst fragments. One should look for bulging of the right lower part of the thorax; also for compensatory hypertrophy of the left lobe of the liver. The x-ray examination, too, may give conclusive evidence of a cyst bulging upward from the dome of the liver, and in old degenerated cysts, gases of putrefaction due to anaerobic infection may bring about peculiar modifications of the light and shade levels.

The cysts of the dome of the liver, tucked away under the shelter of the lower part of the thorax, grow slowly and secretly for 10, 20, 30 years or more and may reach the size of an ostrich egg before they produce ill health. It is only in sensitive regions like the brain, spinal cord, and orbit that a simple un-

complicated cyst causes troublesome symptoms at an early stage. When a fissure or other damage of the parasitological membranes occurs, eroded bile ducts in the adventitia may leak into the cyst cavity and thus cause infection of low or high degree. In the case of the larger ducts the opening may be big enough to allow portions of hydatid membrane and perhaps daughter cysts to descend the ducts and even reach the duodenum, this descent being accompanied by spasmodic biliary colic and jaundice.

Cysts of the liver dome that cause trouble are likely to be large and bulge downward as well as upward, and the abdominal incision serves almost always quite as well as a transthoracic incision for their evaluation, although in difficult cases a prolongation of the incision vertically upward through 2 or 3 of the lower costal cartilages near the sternum is helpful. In rare cases the cyst is really inaccessible by the abdominal approach. It is well to bear in mind that these cysts are usually old with degenerated bile, and contaminated with more or less septic contents, and a study of the cases of this type in the Registry reveals that serious complications and fatalities are just about twice as frequent after the thoracic operation as after the abdominal operation. Pyopneumothorax, for instance, is very common and can be deadly. The pleura possesses a feeble, and the peritoneum a stronger, resistance to infection.

Deep seated lung cysts in young people should be given a chance at spontaneous cure. If, however, sepsis and toxemia become evident, and this is likely to happen if the associated bronchial fistula is small and high up in the cyst wall so that complete escape of the contents is difficult or impossible, operation is indicated. In cases of special difficulty a lobectomy is now advocated. For the common type of lung cysts the two stage operation seems to be favored, but in the author's opinion a one stage technique under high pressure intratracheal anesthesia is preferable. The adhesions produced by the packing, painting, or powdering in the first stage procedure are, more often than not, flimsy and ineffective. Exploratory tapping may be fallacious and dangerous. The injection of formalin solutions, even as weak as 1 or 2 per cent into lung cysts should be resorted to with caution because the frequent presence of bronchial fistulas may lead to alarming and sometimes dangerous respiratory troubles.

Cysts of the heart are extremely rare. In the Registry there were 6 examples. When they occur, they are not usually diagnosed in the curable stage. Sooner or later, if the patient lives long enough, metastatic cysts are carried in the circulation to distant parts and notably to the brain.

JOSEPH K. NARAT, M.D.

**Reimann, H. A., Price, A. H., and Ellis, W. F.: Streptomycin for Certain Systemic Infections and Its Effect on the Urinary and Fecal Flora. *Arch. Int. M.*, 1945, 76: 269.**

The authors have continued their studies of the clinical efficacy of streptomycin therapy in typical

fever. They report, in addition, the effects of this type of therapy as noted in cases of brucellosis, tuberculous meningitis, urinary tract infections, and on the flora normally present in the bowel.

Ten cases of typhoid fever treated with streptomycin therapy are summarized in this article. In 6 patients, definite improvement seemed to be attributable to the streptomycin. Two patients showed no improvement that could be ascribed directly to this drug, and 2 died. No improvement occurred in some instances in which the drug, given intravenously, was present in the blood stream in amounts far above the theoretical bactericidal level. No strict correlation could be obtained as to the concentration of streptomycin effective in vivo as compared to the blood level necessary for clinical improvement, when dealing with the same strain. Different strains of *ebertella typhosa* showed considerable variation in their resistance to streptomycin. Further, the problem was complicated by irregularities in the levels of streptomycin attained in the body with similar dosages in the same patient and in different patients.

Only 1 of 3 patients suffering from brucellosis showed any apparent benefit from streptomycin therapy, although the blood levels obtained were many times the amount theoretically needed for bactericidal efficacy.

Massive doses of streptomycin, 4.0 gm. daily by continuous intravenous drip, were administered to a patient with tuberculous meningitis during the 7 days preceding death. No significant alteration in the spinal fluid or clinical course could be ascertained, although high streptomycin concentration was attained in the spinal fluid.

Parenteral administration of streptomycin promptly suppressed or eliminated the bacillus pyocyaneus, bacillus proteus morganii, and escherichia coli from the urine of several patients; however, therapy was effective only when these bacteria were strains susceptible to the amounts of streptomycin present in the urine. Similarly, the oral administration of streptomycin promptly suppressed or eliminated the escherichia coli and certain other bacteria in the feces during the period of administration, but failed to do so when the strains present were resistant to the concentrations of the drug present.

CLARENCE V. HODGES, M.D.

Parry, E.: Surgery in Malaria. *Lancet*, Lond., 1946, 230: 49.

Malaria may precipitate an acute emergency on the slightest surgical maneuver. The cases cited are of malignant tertian infection by the plasmodium falciparum.

Wounds of patients who suffer from malaria do not heal normally and have a tendency toward hemorrhage with the risk of secondary suppurative. Three cases reported had postoperative bleeding from a compound leg fracture, laceration of the neck, and pelvic fracture with bladder injury, respectively. In all of the cases the plasmodium falciparum was found in the blood stream, and

quinine, given intravenously, proved effective in preventing further hemorrhage. One case showed epistaxis, and in 2 cases bleeding occurred into thyroid adenomas. In another case, there was abdominal pain on the right side, not preceded by generalized pain. Appendectomy was performed and at operation congestion of the appendix and cecum was seen with numerous subserous petechial hemorrhages; postoperatively a large subcutaneous hematoma developed. In still another case postoperative bronchopneumonia was diagnosed, and the plasmodium falciparum was found in the blood stream. In the postmortem examination of 3 other patients who died from bronchopneumonia, the author found intense congestion of the lungs with the plasmodium falciparum in smears taken from these congested areas.

Hemorrhages, large or petechial, caused by malaria lead to confusion in the diagnosis, and may be the cause of complications after surgery. The prompt intravenous use of quinine in surgical cases is very valuable.

ARTHUR J. LESSER, M.D.

Chernoff, H. M., Evans, T. S., and Bartlett, C. J.: Extragenital Chorioepithelioma in the Male. *Arch. Int. M.*, 1945, 76: 347.

Chorioepithelioma is a rare tumor in the male, only about 200 cases having been recorded in the literature. There have been 5 cases reported in which, on adequate gross and microscopic examination of the testes, the tumor was shown to be extragenital in origin.

The authors present an additional case, that of a 30 year old white male who exhibited the clinical picture of a widely metastasizing tumor of embryonal urogenital origin: gynecomastia, lumbar pain, hemoptysis, loss of weight, and a rapid downhill course. Friedman tests of both the urine and spinal fluid revealed the presence of large amounts of gonadotropic hormone. Serial sections of both testes failed to reveal the presence of a primary tumor site. A large retroperitoneal mass in the region of the left kidney was believed to be the primary growth, and it is suggested that the tumor was derived from germinal epithelium in the region of the primitive urogenital anlage. Sections of several metastatic nodules showed the Langhans and syncytial cells typical of chorionic tissue.

CLARENCE V. HODGES, M.D.

Twombly, G. H., and Meisel, D.: The Growth of Mammalian Tumors in Fertile Eggs. Is a Filtrable Cancer Virus Produced? *Cancer Res.*, 1946, 6: 82.

In 1936 Bittner demonstrated for the first time that mammary cancer in the laboratory mouse is related in some way to a substance found in the milk. So-called low tumor strains could be made to develop cancer by feeding the young mice with milk derived from a high tumor strain mother, whereas the incidence of mammary cancer in high tumor strain females could be greatly reduced by foster nursing

them from birth with low tumor strain mothers. In a recent review of the milk influence Andervont concludes that "filtration and ultracentrifugation experiments show that it can be transmitted by cell-free material, and its transmission through many generations of mice implies propagation. These features suggest the action of an agent belonging or related to the viruses." Consequently, when Taylor published the results of experiments in which he had grown mouse mammary cancer successfully in fertile eggs, and then apparently demonstrated the presence of a filtrable viruslike principle in the surrounding yolk that would reproduce the tumor in a few days when injected into susceptible mice, the demonstration of a virus as causative agent of a mammalian tumor did not seem beyond the bounds of possibility according to accepted theory.

The authors attempted to repeat, confirm, and elaborate on Taylor's observations. Rat sarcoma R39, Bagg mouse carcinoma 755, and the RC mouse carcinoma of Taylor have been grown successfully in fertile incubated hen's eggs.

In the authors' opinion, the tumor producing capacity of egg yolk from yolk sacs in which mammalian tumors have been grown is due to the presence of viable tumor cells in the yolk. No convincing evidence of the presence of a virus or filterable agent has been encountered in their experiments.

JOSEPH K. NARAT, M.D.

Deza Cenget, D., and Socci, A.: Cutaneous Carcinoma Produced by Coal Tar, of Pilosebaceous Origin (Carcinoma cutáneo por alquitrán de hulla, de origen pilo-sebáceo). *Form. biogim.*, 1945, 1: 247.

The discovery of cancerogenic properties of certain chemicals is responsible for the fact that infectious and parasitic theories of cancer origin have been discarded. The cancerogenic property of certain substances is linked with the phenanthrenic nucleus which is present in coal tar, coffee, tea, tobacco, products of distillation of oil, and fuel oil. The coexistence of such chemical stimuli with certain biological factors is the necessary requirement for the origin of a neoplasm. Only in this manner can the complete resistance of certain species of animals to the development of cancer be explained.

A certain cycle may be observed in the modifications of tissues of malpighian origin, preceding the experimental formation of cancer, viz.: (1) hyperplasia, (2) hyperkeratosis, (3) papillomatosis, and (4) terminal cancerization. The first two groups represent preneoplastic modifications, while the last two belong to neoplastic lesions.

In contrast to initial epithelial hyperplasia, the author observed an atrophy of the malpighian epithelium which at times was of such intensity as to dominate the histological picture.

According to the German school of thought Krompecher's basocellular carcinoma is of the same origin as a cancer of hornified or spinocellular epithelium, both resulting from a neoplastic proliferation of the basal or germinative layer. According to

the French school, the basocellular carcinoma develops exclusively in the epithelial sheaths of hair follicles.

The authors' studies convinced them that the carcinoma of the epithelial layer produced by coal tar originates in the hair follicles.

JOHN K. NARAT, M.D.

Nocito, F. J.: Sarcoma of the Connective Tissue Spaces and of the Muscles of the Extremities (Sarcoma de los espacios conjuntivos y de los musculos de las extremidades). *Rev. Ar. med. argent.*, 1945, 59: 1291.

The author reports 17 cases of sarcoma of the connective tissue spaces and of the muscles of the extremities. Various names have been applied to this type of tumor, e.g., fascicular sarcoma, sarcoma fusocellulare, fibrosarcoma, conjunctivoma, and sarcoma of the vascular sheaths. The author prefers the term used in the title of his article because it does not indicate the exact origin of the tumor, which may develop in the fascia, fat, or the sheaths surrounding the blood vessels or nerves. Sarcomas of the skin, nerves, blood vessels, lymph glands, serous cavities, tendons, synovial membranes, and articular capsules are excluded from this group. Clinically, it is impossible to differentiate tumors of the muscles from those of interfibrillary connective tissue. The role of an acute or chronic trauma is frequently discussed in the literature, but an intrinsic predisposition is required for the development of a sarcoma following trauma. In some instances a trauma attracts attention to a pre-existing tumor.

Of 17 tumors observed by the author, 5 were located on the upper and 12 on the lower extremities. Of those on the upper extremity, 3 were located on the forearm, 1 was on the elbow, and 1 on the upper arm. Of the 12 tumors of the lower extremity, 3 were located on the lower leg, 6 on the thigh, 2 on the buttocks, and 1 was in the groin.

Muscular sarcomas may be located within or outside of the muscles, invading the adjoining tissues. The size of the tumors varies and may reach that of an adult's head. Invaded muscles usually assume an ovoid shape with the greater diameter parallel to that of the affected extremity. The consistency of the tumor varies, being hard in some cases, soft or fluctuating in others. Fibrous tumors usually have a firm consistency while myxosarcomas are usually rather soft or pseudofluctuating. The last mentioned variety may contain gelatinous zones caused by degenerative processes leading to the formation of pseudocysts which contain blood or brownish liquid.

Compression of the veins by tumor masses may produce edema involving the tumor and responsible for a pseudomyxomatous aspect. Intratumoral hemorrhages cause a pigmentary infiltration and melanotic aspect. Rhabdomyosarcomas are rare and their macroscopic identification may be impossible when they invade the adjacent tissues. Some sarcomas contain zones of ossification or cartilaginous tissues because of the corresponding properties of

mesenchymal cells. Such tumors are called osteoblastic or chondroblastic fibrosarcomas, respectively.

One of the most important characteristics of sarcomas of the connective tissues is the capsule. In voluminous tumors the capsule may be defective, which facilitates invasion of the adjoining tissues. The clinical evolution and the histological examination do not support the benign appearance of the tumor created by the capsule. It should be remembered that the capsule does not form a defensive barrier.

There is a variety of infiltrating rhabdomyosarcoma in which it may be impossible to determine the extent of the tumor because the neoplastic mass infiltrates and dissociates the muscular fibers in a manner similar to epithelioma.

Important nerves such as the median or sciatic nerve may be invaded, which suggests the origin of the sarcoma to be from the nerve itself.

Invasion of the lymph glands is rare. Muscular fibers may be incorporated in the tumor mass and may show signs of fragmentation or other alterations produced by degenerative reactions which precede the neoplastic invasion.

From the histogenetic point of view the following classification may be offered: (a) Nondifferentiated sarcomas with mesoblastic cells, and (b) differentiated sarcomas: (1) fibroblastic sarcomas, (2) rhabdomyosarcomas, (3) lipoblastic sarcomas, (4) mixosarcomas, (5) angioblastic sarcomas, and (6) osteoblastic sarcomas.

The skin overlying the tumors may be freely movable or adherent to the tumor. Ulcerations are not infrequent. Ischemic processes may be responsible for the soft consistency of the large fibrosarcomas. The encapsulation explains a certain mobility of tumors. Muscular contractions usually immobilize the tumor, but this sign does not necessarily indicate that the neoplasm originated within the muscle because the same sign may be present in sarcomas located below the aponeurosis or between the muscles. Edema of the involved extremity is frequent, being caused by compression of the veins. Arterial compression is less frequent and is detectable by a diminution or suppression of the pulse.

As a rule regional adenopathies are not demonstrable. Compression of the nerves may cause pain, atrophy, or paralysis of the muscles. Exploratory aspiration, although recommended by the author, frequently gives negative results. X-ray examinations show no connection between the tumor and the skeletal system. Intratumoral opacities caused by calcification or ossification may be detectable. Chest roentgenograms should never be omitted because only by this means may pulmonary metastases be demonstrated.

The general condition of the patients remains good for a long time. Blood examination may show uremia or leucocytosis, especially if hemorrhage and infection are present. Fever may accompany cachexia.

Sarcoma may penetrate the skin and form a so-called sarcomatous fungus. Recurrence of the fibrous

tumors may appear several years after their excision while in other types of neoplasms recurrences usually develop at an earlier date.

Cough, hemorrhage, sputum and pain are late manifestations of pulmonary metastases, but the metastases are detectable earlier in roentgenograms.

The prognosis is bad in spite of a slow progress of the tumors, mobility, and the absence of pain. Sarcoma of the proximal portions of the extremity gives a poorer prognosis than that of distal portions. The larger the tumor the poorer the prognosis. The younger the age of the patient the more serious the prognosis.

Subaponeurotic location of the tumor, its independence from the bony structures, and a progressive growth are characteristic. Tumors of the tendon sheaths and serous cavities may be differentiated by their benign evolution and their location. Synovial cysts can be recognized by their periarticular location and smooth outlines; they may be reducible and of a remittent character. Benign and malignant tumors of the skeletal system may be recognized in roentgenograms. Chondromas are usually multiple. Osteogenic exostosis is hard and situated in the region of the metaphysis. Osteogenic sarcoma is found most frequently on the lower extremities, especially on the thighs; it is hard and painful. Solitary myeloma is deeply located, immobile, and recognizable in roentgenograms. Syphiloma may simulate a sarcoma. Serological examination usually clears up the diagnosis. The sclerosing form of muscular tuberculosis and infectious myositis are rare lesions of a diffuse character. Frequently a fluctuation is found. Sporotrichosis manifests itself in the form of multiple subcutaneous nodules adherent to the skin. Deeply located lipomas are soft or pseudofluctuating tumors which may be easily confused with sarcomas. Muscular angiomas are very rare. They are painful and compressible. Neurinomas are located along the trunks of large nerves, such as the median and sciatic nerves.

Biopsy may accelerate the growth of the tumor, and therefore should be performed only if a surgical intervention can immediately follow the histological diagnosis.

The following methods of treatment are available: (A) x-ray or radium therapy; (B) surgical procedures: (1) enucleation, (2) wide excision of the tumor with the adjoining tissues, (3) amputation or disarticulation; and (C) combined treatment consisting of preoperative irradiation followed by operation.

The results of surgical treatment are by far superior to those of irradiation therapy. Wide excision of the tumor preceded by irradiation may be recommended for tumors located in the distal region of the extremities. If extirpation of the tumor would probably interfere with the blood supply of the involved extremity, or if the surgeon is dealing with a recurrent tumor, a mutilating operation is indicated. In advanced cases a test irradiation may be employed: if the size of the tumor diminishes rapidly, irradiation should be continued because such tumors are

usually very malignant and the frequency of post-operative pulmonary metastases is great. If the tumor does not yield to irradiation, it should be removed. In inoperable cases, x-ray therapy is the only method of treatment.

JOSEPH K. NARAT, M.D.

### DUCTLESS GLANDS

Sayers, G., Sayers, M. A., Tsan-Ying Liang, and Long, C. N. H.: The Effect of Pituitary Adrenotropic Hormone on the Cholesterol and Ascorbic Acid Content of the Adrenal Glands of the Rat and the Guinea Pig. *Endocrinology*, 1946, 38: 1.

The injection of highly purified adrenotropic hormone into rats and guinea pigs was followed by a prompt fall in the adrenal ascorbic acid, and a slower fall in the adrenal cholesterol. The levels of these substances in other tissues were not affected.

Following the injections, the adrenal cholesterol slowly returned to the initial level in 24 hours in both species. The rate of return of the adrenal ascorbic acid was quite rapid in the rat. In the guinea pig, the level remained depressed for some hours and then slowly rose, but the level was still subnormal 24 hours after the injection.

Coincidentally with the fall in adrenal ascorbic acid and cholesterol, there was an increased deposition of liver glycogen in both the rat and the guinea pig. These changes in adrenal ascorbic acid and cholesterol, under the influence of adrenotropic hormone, may be associated with the formation and release of the adrenocortical hormones.

SAMUEL KAHN, M. D.

Astwood, E. B., Bissell, A., and Hughes, A. M.: Further Studies on the Chemical Nature of Compounds Which Inhibit the Function of the Thyroid Gland. *Endocrinology*, 1945, 37: 456.

The effect of 220 antithyroid compounds, orally administered in the diet, on hypertrophy and hyperplasia of the thyroid glands of rats was estimated by determinations of weight and iodine content of the glands by methods previously described. The results of a 10 day feeding period are plotted on a log dosage scale and compared with the effects of thiouracil, which are taken as the unit of activity. An example of one experiment with thiouracil is plotted and the effects of the other compounds are tabulated. The tables include the name and formula of the compound, its source, the number of tests conducted, the dose tested, the gain in body weight per day, the thyroid weight and iodine content, and the estimated activity of the compound compared with thiouracil. The compounds included 22 thiourea derivatives; 10 imidazoles and imidazolines; 18 thiazoles, thiazolines, and oxazolines; 17 mercapto or thio derivatives of 5 or 6 membered heterocyclic ring compounds; 15 other sulfur compounds related in one way or another to the compounds already mentioned; 9 thiopyrimidones; 46 thiouracil derivatives; 39 thiobarbituric acids; 28 aminobenzene derivatives; and 16 benzene derivatives lacking an amino on the aromatic ring.

Of the 220 substances tested, 115 had detectable activity and 25 were as active or more active than thiouracil. The most active were the thiouracil derivatives, and their activity is listed in decreasing order, taking thiouracil as unity: 6-n-propyl, 11; 6-benzyl, 10; 6-tert-butyl, 9; 6-ethyl, 8; 6-sec-butyl, 6; 6-isobutyl, 5; 5-ethyl, 3.5; 5-methyl, 6-ethyl, 3.5; 6-n-butyl, 3; 5-isopropyl, 2.5; 5-n-propyl, 2; 5, 6-diethyl, 2; 5, 5-diethyl-2-thiobarbituric acid, 1.7; 2-mercapto-imidazole, 1.5; 2-mercaptothiazoline, 1.3; and 5-amino-2-mercapto 1, 3, 4-thiadiazole, 1.2.

Two types of chemical structure are found to be associated with antithyroid activity, the most active possessing a thiocarbonamide grouping and the least active an aminobenzene group.

Environmental temperature, humidity, and iodine intake were not controlled, but there was considerable agreement between the results of the authors and those of McGinty, Bywater, and Jenes (J. Pharmacol. Exp. Therap., 1945, 84:342; 85:11, 129) with regard to 20 compounds. These authors more carefully controlled the iodine intake and temperature in experiments in which some 120 compounds were tested.

CLINTON H. THIENES, M.D.

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The pituitary glands of 10 patients who came to autopsy were studied. All of the patients had been extremely obese. Nine pituitary glands from persons who had no physical or historical evidence of past or present obesity and who corresponded closely in age and sex were used as controls.

In all 10 of the obese persons there was an increase of the basophilic cells of the pituitary gland. The change was marked in 6 and moderate in 4. The eosinophils were decreased in 2. There was a pronounced increase of the chromophobes in 5. Small adenomas of the gland were found in 4 obese patients. A peculiar relatively circumscribed scarring was found in 9 patients, being absent only in 1 patient. A marked increase in colloid was found in 3 obese patients and a moderate increase in 1 patient. Pronounced vacuolation of the basophilic cells was present in 6 cases of the obese group; in 3 others this change was present to a slight extent.

No changes similar to these were found in the 9 selected control cases.

Although the pituitary changes in these obese patients, consisting of this peculiar scarring of the stroma and a predominance of the basophils with some increase in the chromophobes, were striking, their causal relationship to the development of obesity was not determined.

E. A. GOVVERT, M.D.

### EXPERIMENTAL SURGERY

Florey, Sir H., and Others: Mycophenolic Acid. An Antibiotic from *Penicillium Brevicompactum* Dierckx. *Lancet*, Lond., 1946, 250: 46.

Mycophenolic acid was extracted and crystallized from a culture of *penicillium brevicompactum*.

TABLE I.—INHIBITORY EFFECTS OF MYCOPHENOLIC ACID ON PATHOGENIC FUNGI

Fungus	N.C.T.C. no.	Titer of inhibition	
		At 2½ weeks	At 4 weeks
Microsporum Group—			
Sab. audouinii	2526	5000	5000
Sab. audouinii	3005	Partial*	Partial
Sab. felineus	3006	5000	Partial
Sab. felineus	2524	Partial	None
Sab. lanosus	2525	Partial	Partial
Msp. fulvum	3007	5000	Partial
Msp. equinum	3008	20,000	20,000
Msp. ferrugineum	3009	40,000	40,000
Msp. japonicum	2106	None	..
Endothrix Group—			
T. tonsurans	2520A	80,000	40,000
T. tonsurans	2987	80,000	Partial
T. effractum	2992	40,000	20,000
T. fumatum	2997	80,000	10,000
T. sabouraudii	2521	40,000	40,000
T. sabouraudii	2988	80,000	20,000
T. louisianicum	2786	Partial	None
T. sulphureum	2522	20,000	Partial
Rodinea violacea	2990	80,000	20,000
T. decalvans	2784	80,000	10,000
T. cerebriforme	3000	80,000	10,000
T. plicatilis	2999	None	..
Ectothrix Group—			
T. asteroides	3002	Partial	Partial
T. lacticolor	3001	20,000	Partial
T. granulolum	3003	5000	Partial
T. persicolor	2993	None	..
T. equinum	2996	10,000	10,000
T. album	2993	80,000	20,000
T. discoides	2995	10,000	10,000
T. balcanicum	704A	80,000	10,000
(T. depressum)	3004	None	..
Favus Group—			
Achorion gallinae	3015	5000	5000
Achorion gypseum	3013	None	..
Achorion violaceum	3012	80,000	20,000
Achorion quinckeianum	3011	80,000	20,000
Grubyella schönleini	3010	80,000	80,000
Epidermophyta—			
Epi. cruris	2780	80,000	20,000
Epi. perneti	3016	20,000	10,000
Epi. rubrum	702	20,000	20,000
Endodermophyta—			
Endo. indicum	703	40,000	Partial
Endo. tropicale	1753	None	..

The range of the twofold dilution series was from 1 in 5000 to 1 in 80,000. Figures show the highest dilution of mycophenolic acid which completely inhibited growth (1 in ...). In most cases where complete inhibition is recorded at a low dilution there was also partial inhibition at higher dilutions.

\*Where partial inhibition is recorded, growth was diminished but not totally suppressed at 1 in 5000 and usually at one or more higher dilutions also.

*T. depressum* appears in parentheses because its group is not determined.

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Dierckx (National Collection of Type Cultures No. 3568).

Serial dilution of sodium mycophenolate showed stronger action against the gram positive than against the gram negative organisms. There was apparently no destruction of mycophenolic acid by the bacteria, the majority of which proved sensitive to the antibiotic. Staphylococci could be proved to acquire resistance to mycophenolic acid at a fairly rapid rate—a 16-fold increase in resistance in the third culture. Serum reduced the activity of mycophenolic acid by less than 50 per cent.

Most of the leucocytes were killed immediately by a concentration of 1:200, but a dilution of 1:1000 showed no effect on their motility or survival. The intravenous medium lethal dose for mice of from 18 to 21 gm. was about 10 mgm., and organ studies in the mouse after different methods of administration—oral, subcutaneous, and intravenous—showed good absorption from the subcutaneous tissue and

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The antibiotic was effective against a number of saprophytic fungi and Table I summarizes the effect against pathogenic fungi. It also proved to be effective against a number of fungi and bacteria which are pathogenic to plants. Its antibacterial effects are greatly affected by the size of the inoculum. Mycophenolic acid is the first antibiotic produced by a mold known in crystalline form.

ARTHUR J. LESSER, M.D

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Sanders, A. G.: The Effect of Some Antibiotics on Pathogenic Fungi. *Lancet*, Lond., 1946, 250: 44.

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species of fungi grown in a liquid medium (sterile glucose-peptone water, with a pH from 6.5 to 7.0). The cultures were obtained from the National Collections of Type Cultures and were grown on glucose agar for from 2 to 4 weeks. Small and equal pieces of mycelial felt were then placed into tubes containing the antibiotic and were incubated at 24 degrees C. for about 6 weeks; they were inspected at intervals of from 7 to 10 days. The antibiotics were also tested in serial dilutions ranging from 1:5000 to 1:160,000, and in the case of the little soluble gliotoxin, from 1:140,000 to 1:1,000,000.

No inhibition of growth was noted with penicillin (100 units/c.cm.) and helvolic acid (1:5500). Penicillic acid (1:5500) delayed the growth of 9 of 20 species tested, but lost activity rapidly during incubation. Gliotoxin (1:140,000) showed complete inhibition for 5 species, retardation for 11, and no inhibition for 10 species; however, it appeared to be unstable under these conditions. Aspergillic acid (1:5000) and cheiraline (1:5000) both completely inhibited the growth of all 37 species examined and possibly would repay further investigation. Results with mycophenolic acid are published separately.

ARTHUR J. LESSER, M.D.

Kinney, T. D., Haynes, F. W., and Dexter, L.: Experimental Production of Pulmonary Embolism by the Use of a Venous Catheter. *J. Lab. Clin. M.*, 1945, 30: 1013.

Methods for the experimental production of pulmonary embolism fall into two groups: embolism and ligation. The method most commonly employed has been the introduction of various kinds of foreign

bodies into the peripheral venous system. Its disadvantage is that the site of lodgment cannot be controlled and the ultimate action and effect on the lung cannot be predicted. Direct ligation has the disadvantage that the thorax must be opened and there is consequently a disturbance of the pulmonary and cardiac dynamics.

The method described consists in the introduction into the jugular vein of a number 8 or number 11 catheter 60 centimeters long with the tip bent at an angle of about 60 degrees. Under direct fluoroscopic examination the catheter is directed down the vein through the superior vena cava and into the right auricle. The catheter is manipulated into the right ventricle and into the pulmonary artery, and once in the artery it is possible to direct it into the right or left branch and into the smaller ramifications if so desired. The position may be ascertained with certainty by observing the tip of the catheter to be outside of the cardiac shadow. When in position, emboli may be injected directly into the pulmonary circulation. The method does not produce damage to the linings of the vessels or the heart.

Japan wax was used as a medium for studying the location of the embolus because its melting point is low and it readily congeals at the body temperature of the dog. The extent of the pulmonary vascular bed deprived of its blood supply can be readily controlled by the amount and type of embolic material used. An example obtained by using Japan wax showed the embolus to be in the form of a cast of the pulmonary artery and was reminiscent of emboli seen in massive pulmonary embolism in man.

HARVEY S. ALLEN, M.D.

# SURGERY

## GYNECOLOGY AND OBSTETRICS

VOLUME 83

AUGUST, 1946

NUMBER 2

### THE FATE OF PRESERVED HETEROGENEOUS GRAFTS OF FASCIA WHEN TRANSPLANTED INTO LIVING HUMAN TISSUES

JACOB CHANDY, M.B., B.S., M.Sc., Philadelphia, Pennsylvania

THE importance and significance of the use of heterogeneous preserved fascia, especially in plastic surgery, have commanded the attention of many investigators. This present study is concerned with the changes which take place when preserved ox fascia is placed in contact with living human tissue. Such grafts have been studied over periods up to 4 years.

As soon as the animal was killed, the deep fascia was removed, aseptic precautions being used, and the grafts were placed in a solution of 70 per cent ethyl alcohol. While immersed in the alcohol the fascia was cleaned and cut into 2 inch by 2.5 inch pieces and finally transferred into absolute alcohol. After 2 weeks the pieces were considered available for use.

The prepared pieces of fascia were implanted into human tissue during various operative procedures, especially operations for hernia as advocated by Harrison. The implants were removed at subsequent reoperations at intervals up to 4 years in duration.

*Specimen 1* is a section of normal preserved ox fascia before implantation into human tissue. Well preserved fibrous tissue is evident. Note that the nuclei are readily seen. The cell outlines are clear, and the cells are arranged uniformly. Blood vessels are not visible. The compact nature of the fascia is evident.

*Specimen 2* is a section of preserved ox fascia 1 week after implantation into human tissue. Very little change is noted. A few leucocytes are seen infiltrating the periphery. No foreign body reaction is seen. The fascial structure is preserved.

*Specimen 3* is a section of preserved ox fascia 2 weeks after implantation into human tissue. No marked change is seen in the ox fascia, except that more leucocytes are present at the periphery and fibroblasts are beginning to infiltrate into the graft.

*Specimen 4* is a section of preserved ox fascia 3 months after implantation into human tissue. The well defined cell outlines and staining characteristics have changed. There is evidence of absorption at the periphery. Fibroblasts are observed growing into the graft, and capillary growth is also seen. The uniformity of arrangement of the fascial fibers is being changed to an arrangement in bundles, and more cells are seen between these bundles.

*Specimen 5* is a section of preserved ox fascia 8 months after implantation into human tissue. There is observed a progressive change in that more fibroblastic growth into the graft is further defining the bundles seen in specimen 4. There is more absorption by the migrating cells at the periphery. No evidence of a foreign body reaction is seen.

*Specimen 6* is a section of preserved ox fascia after 2 years of implantation into human tissue.

From the Mission Hospital, Bahrein, Persian Gulf.

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sue. The fibroblasts of the host have grown into the graft very well. Cell outlines in the original graft are largely lost. Capillary invasion is marked, but the transplanted fascia can still be readily identified. There are more leucocytes and migratory cells at the periphery than in specimen 5.

*Specimen 7* is a section of preserved ox fascia after 4 years of implantation in human tissue. Good capillary growth is evident at the periphery. A network of collagen fibers and fibroblasts has grown into the fascial graft completing the division into bundles. The nuclei of the original fascial fibers have disappeared. Note the absorption of the peripheral bundles and their extensive replacement by collagen fibers. The preserved tissue can still be easily distinguished from the living tissue.

#### OBSERVATIONS

The most evident features are:

1. The preserved ox fascia can be identified after 4 years of implantation in human tissue.
2. There is a very slow change in the character and nature of the preserved fascial fibrous tissue cells.

3. There is an abundant growth of capillaries and fibroblasts from the periphery into the fascial graft and complete absorption of the preserved fascial cells at the periphery.

4. The absorption of the cellular detritus of the preserved fascia is noted.

5. The fibers of the preserved fascia become rearranged into bundles as more fibroblastic and capillary ingrowth takes place.

6. There is relatively little leucocytic infiltration at the periphery of the graft and between the bundles.

7. There is no marked foreign body reaction, and giant cells are absent.

#### DISCUSSION

The use of dead material as grafts has been based principally on the work of Nageotte and Sencert (13, 14, 15). Nageotte (11) in 1916 formulated a theory of the nature and origin of connective tissue. He believed that albuminoid coagula are first formed from the parenchymal cells, that these coagula should not be regarded as living, and that their origin is similar to the formation of blood plasma. He called this coagulum "the fundamental sub-



Fig. 1.



Fig. 2.

stance," and he believed that it was composed of elementary collagen fibrils which give rise to collagen fibers, and that connective tissue is formed by the penetration of fibroblasts into the meshes of these fibers. The distinctive feature of Nageotte's theory is that he insists upon the fundamental nonliving character of all connective tissue substances. Baitzell's (2, 3) work supports Nageotte's conclusions. The other theories held regarding the formation of connective tissue are that it is made up of transformed portions of the exoplasm which comes from a syncytium of mesenchyme cells and also that the early syncytium of the mesenchyme cells secretes an amorphous gelatinous nonliving ground substance in which the connective tissue fibers form. Baitzell (4) observed also the direct transformation of fibrin clot into connective tissue fibers. Tissue cells which grew into the fibrin clot developed into fibroblasts.

Nageotte believed that, since connective tissue substances are inert coagula formed from living cells, one would not expect grafts of such tissues to act as foreign bodies and induce phagocytosis, and similarly connective



Fig. 3.

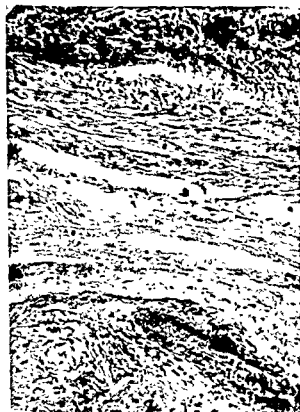


Fig. 4.



Fig. 5.



Fig. 6



Fig. 7.

tissue preserved in alcohol, since they have the same nonliving origin, should not produce phagocytosis and foreign body reaction. In other words, reaction to preserved fibers should be the same as that to living ones. He explained the results of his experiments on the theory that the nonliving graft takes and becomes adherent; that it soon becomes impossible to determine its limits because the union between the living and nonliving tissue has effected itself so perfectly. In his experimental studies the microscopic examination showed that the implanted graft blended with the living tissue until no line of demarcation could be detected. After the protoplasm of the cells of the preserved graft had been carried off by the migratory cells, or wandering macrophages, new fibroblasts from the host flocked into the persisting connective tissue framework of the graft and established themselves in the place of the old inhabitants. Circulation became established by the growing in of small vessels from the host, and in time it was actually impossible to tell that the graft has been dead when it was implanted. Nageotte called this process the "reviviscence." The

only phagocytosis which he was able to observe was that which was necessary for the removal of protoplasm of the preserved graft. Nageotte grafted, with success, cartilage, tendon, segments of arteries, and nerves.

Nageotte (12) and Sencert (17), Auvray, Dustin, Jalifier, Christophe, and many others have grafted successfully preserved animal tendon, nerves, and even an entire patella with good results.

The animal experiments of Koontz are of significance in this connection—heterogeneous and homogeneous grafts did not show any difference—they both healed and did not show any intolerance of the host tissues for the graft. Koontz believed that the preservation of the graft in alcohol eliminates the antagonistic action of foreign protein. It is an important fact that fibroblasts did not grow around the grafts at any time in sufficient numbers to produce encystment. No foreign body reaction was noted by Koontz. He concluded that after a period of a few months it would be impossible to distinguish the living from the preserved tissue graft after that had been transplanted into living connective tissue.

The results of the experimental work of Hass agreed very closely with those of Koontz. He showed that the transplanted preserved fascia united firmly with the muscle and did not tend to take the form of tendinous structures as the live graft usually did. Microscopically close intermingling of the muscle and the transplanted fascia was observed. There was no evidence of a foreign body reaction. There was no difference between the union of preserved fascia with the muscle and that of living fascia. Muscle cells appeared to be transformed into the elements of fibrous tissue and aided in the uniting process.

Rosenblatt and Meyers found very good union between preserved fascia and living tissue although they noted some foreign body reaction around the graft. They believed that the fascial graft acted as an element for substitution of connective tissue and was in part absorbed.

There is no evidence in the observations reported in the present study to support Nageotte's theory of the nature and origin of the connective tissue. From the data obtained in my experiments it is clear that the preserved tissue does not in itself become a living tissue at any time although the value of the preserved tissue is quite evident. When a tissue is dead, its intracellular chemistry changes, and the devitalized material is absorbed and replaced by other tissue cells. The absorption may be slow if the material has been fixed in alcohol. The amount of foreign body reaction depends on the chemical and physical nature of the foreign body; and since fixed connective tissue cells are not irritating, they need not produce such a reaction. However, there occurs sufficient phagocytosis for the absorption of the foreign cellular detritus. This is well seen in the sections.

It may not be advisable to use the expression that preserved tissue unites or heals with living tissue, as used by Nageotte, Koontz, and others. It remains an integral part for a long time but eventually is replaced, at least

to a considerable extent, by living fibroblasts to form new connective tissue.

The importance of such preserved fascia lies in the fact that it can be used in various plastic surgery procedures as a framework into which normal tissues may grow. It has sufficient strength to serve in place of normal tissue for long periods of time, and it rapidly becomes firmly attached to these tissues in man.

## SUMMARY

A study of the fate of preserved heterogeneous grafts of fascia when transplanted into living human tissue is reported. Such grafts have been observed and studied over a period of 4 years.

The preserved fascia rapidly becomes adherent to the human tissues and remains so for a long period of time. It is gradually replaced by the ingrowth of fibroblasts and capillaries and the formation of human connective tissue. This process was still incomplete, however, after 4 years.

A short review of the experimental studies in fascial transplants is given.

Photomicrographs of sections of preserved ox fascia after periods of from 1 week to 4 years in living human tissue are presented.

The advantage of preserved ox fascia in plastic surgical work is emphasized.

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# PERITONITIS OF APPENDICEAL ORIGIN TREATED WITH MASSIVE DOSES OF PENICILLIN

## Report of 50 Cases

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THE purpose of this article is to report a group of 50 cases of proved peritonitis of appendiceal origin which were treated with large doses of penicillin over a long period of time. The peritonitis was controlled in all cases and all intra-abdominal masses resolved spontaneously without drainage. The dosage of penicillin was 100,000 units given every 2 hours, intramuscularly, for 2 to 6 days, followed by smaller amounts for 3 to 4 days.

### REVIEW OF LITERATURE

In spite of the fact that penicillin has been widely used in the treatment of peritonitis, little has been written on this subject. Craig and others report 7 cases of peritonitis in which 20,000 units of penicillin was given every 2 hours with good results in the majority of the cases. There is no report in the literature of a series of cases of peritonitis treated with large doses of penicillin given over a long period of time. Yet in 1944, Fauley and others reported that in dogs peritonitis induced by ligation of the blood supply of the appendix could be controlled by the administration of penicillin in doses equivalent to 22,500 units per hour given to a 150 pound man over a period of 7 days. The mortality in untreated controls was 92.6 per cent; the mortality in those treated from the time of operation was 0 per cent, and the mortality of those treated after 12 hours was 21 per cent.

It has been established by the work of Ory and others that penicillin given parenterally enters the serous cavities of the body and is present in ascitic fluid in approximately the same concentration as in the blood (7). Loewe and others, moreover, have established that the level of penicillin attained in the blood is almost directly proportional to the dosage of penicillin given intramuscularly or

intravenously. When 100,000 units of penicillin is given intramuscularly the level in the blood rises to 1.7 units per cubic centimeter of blood 30 minutes after the injection, falls to 0.8 unit 60 minutes after the injection, and to 0.3 unit after 120 minutes. Craig and others state that a level of 0.02 unit per cubic centimeter is effective for the control of most organisms sensitive to penicillin. It is thus apparent that when 100,000 units of penicillin is given every 2 hours, the lowest levels, occurring just before the next injection, are still over 10 times in excess of minimal effective levels, and the maximum levels are over 80 times as high. There is reason to believe that it is necessary to maintain these high levels over a long period of time if peritonitis secondary to appendicitis or perforation of the colon is to be controlled.

### CLINICAL MATERIAL

#### *Definition of peritonitis of appendiceal origin.*

From November 1, 1944, to November 1, 1945, at the U.S. Naval Hospital, San Diego, over 900 appendectomies were performed. In approximately 70 per cent of these cases, true acute appendicitis was present. In a little over 5 per cent of the cases, peritonitis was found. It is this group of patients, with peritonitis of appendiceal origin, with which this paper is concerned.

For this study no case was accepted as peritonitis of appendiceal origin unless at the time of operation an established purulent peritonitis or appendiceal abscess was present. Cases in which the appendix was ruptured in its removal but in which there was no evidence of an established peritonitis were eliminated.

If operation was deferred and the peritonitis was treated conservatively, such a case was not included unless there was strong clinical evidence of peritonitis subsequently

proved by the development of a palpable mass or by an interval operation confirming the presence of a gross perforation of the appendix. Also excluded from this group were patients who did not develop a mass and who either did not have an interval appendectomy or whose appendix at the time of appendectomy failed to show gross evidence of perforation.

Twenty-five of the 50 patients in this group were considered on clinical grounds to have generalized and 25 to have localized peritonitis. In 8, definite abdominal masses were palpable at the time of admission and in 25, pelvic or abdominal masses were palpable at some time during the course of the illness. All of the patients were sick, and it is clear that their illnesses represent the most serious complications of appendicitis.

The following information concerning the 50 cases of proved peritonitis is of importance: The average temperature on admission was 102.6 degrees, with a high of 105 and a low of 100. The average pulse on admission was 109, with a high of 130 and a low of 90. The average white blood count on admission was 17,000, with a high of 30,000 and a low of 5,000. The average duration of illness prior to entry was 3.2 days. There were 25 patients with general peritonitis, 25 with localized peritonitis, 8 in whom a mass was palpable on admission, 25 in whom there was a palpable mass at some time (15 pelvic and 10 abdominal). Conservative treatment of peritonitis was carried out in 23<sup>1</sup> patients, exploratory operation without appendectomy in 5, immediate appendectomy in 22.

The average duration of the illness before admission of patients subjected to appendectomy was 2.9 days, and of those treated conservatively, 3.8 days. In only 2 cases were the symptoms over a week's duration. Treatment, if any, prior to entry, had consisted in a small percentage of cases, of the administration of sulfonamides and in 2 or 3 instances of small amounts of penicillin. In 5 cases sulfanilamide was placed in the peritoneal cavity at the time of operation, and in 1 case 200,000

units of penicillin solution was left in the abdomen.

A McBurney incision was used in all but 4 of the cases. The stump of the appendix was not inverted, and fine cotton or catgut was used for closure of the abdominal wall.

#### TREATMENT OF PERITONITIS

*Penicillin.* As soon as the diagnosis of peritonitis was made, all patients were given 100,000 units of penicillin every 2 hours intramuscularly in procaine solution or by continuous intravenous drip. This treatment was continued until signs of improvement appeared. The longest course of this dosage of penicillin was 10 days, the shortest was 1 day, and the average was 3½ days. In the beginning of the period in which these cases appeared, when penicillin was scarce and costly, every effort was made to use as little as possible and the dose was usually halved after the first day. Later it was found more economical to give the larger doses for at least 3 or 4 days and then to continue with 50,000 units every 2 hours or 100,000 units every 4 hours for at least 3 more days. If the large doses were discontinued too soon, recurrences of the peritonitis were apt to appear or the patient developed a localized mass. A second course of penicillin would again result in the subsidence of all symptoms and signs of peritonitis and in the ultimate resolution of the mass (Fig. 1).

In the early days of this experience with penicillin, an attempt was made to set up a standard treatment for all cases. One hundred thousand units was given every 2 hours for the first day, then 50,000 units every 2 hours for 2 days, 50,000 units every 4 hours for 2 days, and finally 25,000 units every 4 hours for 2 days. On several occasions there were recurrences of elevation of temperature and of the symptoms and signs of peritonitis while the patient was still receiving 25,000 units of penicillin every 4 hours. The schedule was changed therefore, and the full dosage was maintained until the clinical signs of peritonitis subsided or until the patient had been on 100,000 units of penicillin every 2 hours for at least 6 days. Four days was sufficient to control the average case, and if satisfactory improvement occurred, the dosage

<sup>1</sup>In all but 3 cases, interval appendectomy confirmed the presence of a gross perforation of the appendix. In the other 3, operation was not performed, but diagnosis was established by the development of a definite mass in the right lower quadrant.

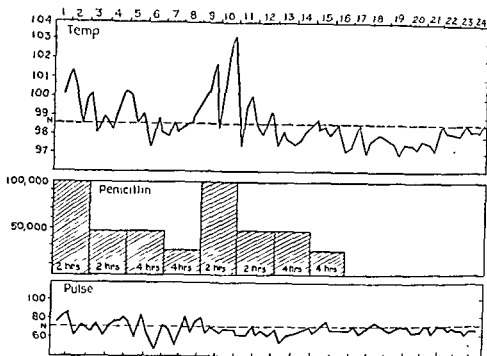


Fig. 1. Localized peritonitis, 2 days' duration, with mass in right lower quadrant. All symptoms and signs subsided on treatment with penicillin. Recurrence when dosage was reduced to 25,000 units every 4 hours. Mass, fever, and symptoms permanently controlled with second course of 100,000 units of penicillin every 2 hours.

was reduced to 100,000 units every 4 hours. Fifty thousand units every 2 hours maintains a better level in the blood, but after 4 or 5 days the patients complain about the injections, and since by this time they are usually feeling much better, it is sometimes difficult to keep their co-operation. It is unwise, however, to discontinue large doses of penicillin on at least a 4 hour schedule before the sixth day of treatment, and sometimes 10 or 12 days may be required before large intra-abdominal masses begin to resolve.

The dosage, 100,000 units every 2 hours, is an arbitrary one and may be higher than required for some, and lower for others. Several patients responded well to 50,000 units every 2 hours, and 1 patient responded slowly to doses of 200,000 units every 2 hours. At least 3 patients receiving 30,000 units every 3 hours showed evidence of the spread of peritonitis or developed recurrences of localized masses with rising temperature and pulse rates when the dosage was lowered to this level. Similarly, several patients who had responded dramatically to large doses of peni-

cillin developed recurrences of their peritonitis when the administration of penicillin was discontinued after 1 or 2 days. In all of these cases the disease was again controlled by the prolonged administration of 100,000 units every 2 hours. Since side effects appear to be no more common when large doses are used than when the usual ones are given, and since the drug is now relatively inexpensive, it would seem safer to err on the side of overdosage. This point of view is supported by experiences in the treatment of sulfonamide or penicillin-resistant gonorrhea, in which studies it has been observed that if inadequate doses are at first given, a resistant strain of gonococcus is apt to develop (3).

There is reason to believe that certain of the commercial preparations of penicillin contain more of the fraction X than others. This fraction is from two to eight times more effective against the hemolytic streptococcus, the gonococcus and other organisms than is the fraction G, although its efficacy against the standard test organism, staphylococcus, is the same (8).

At one time, in this series, there was a group of 14 cases which did not respond as well as the previous cases had, and in checking back it was found that the brand of penicillin had been changed. At the same time, on another service, there was encountered an extraordinarily high percentage of penicillin-resistant cases of gonorrhea. When a different brand of penicillin was used, the penicillin-resistant cases obtained good results. One patient with peritonitis, resistant to the first brand of penicillin, responded promptly to a course of treatment with the second. Five brands of penicillin in all have been used in this series, and all but one have proved satisfactory.

**Position.** No attempt was made to maintain Fowler's position unless abdominal distention or dyspnea rendered the patient more comfortable in this position. Bed rest was insisted upon until the patient became afebrile.

**Diet.** Clear fluids were allowed *ad lib.* from the time of entry unless the patient was distended or vomiting. If the patient was unable to take adequate fluids by mouth or if distended, 5 per cent glucose in water or saline was given intravenously to make a total intake of 3,000 cubic centimeters daily.

**Gastric suction.** Continuous gastric suction was used in patients who were distended or vomiting. The amount of fluid and salt lost by suction was estimated and replaced parenterally. Patients were allowed to drink clear fluid.

**Miller-Abbott tube.** If gastric suction failed to decompress the abdomen or if the returns from the stomach indicated that ileus was present, a plain plate of the abdomen was taken. If this showed the slightest evidence of small intestinal obstruction, a Miller-Abbott tube was passed without delay. As soon as the Miller-Abbott tube passed the pylorus, the patient was allowed to take clear fluids, and when the tube had entered the ileum a soft diet was given.

It was not found necessary or desirable to use hot stupes on the abdomen. None of the patients in this group was seriously ill more than 4 days, and none went more than 4 days without taking food by mouth. For this reason, the glucose was not supplemented with amino acids. Since the plasma proteins did

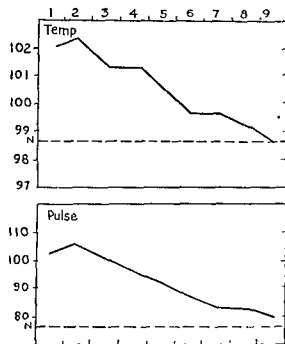


Fig. 2. Composite temperature chart of 21 consecutive cases of peritonitis treated with large doses of penicillin.

not fall and since edema occurred in no case, plasma was not necessary. In no instance did anemia below 65 per cent hemoglobin occur, and no transfusions were given. The leucocytes showed little alteration during the febrile part of the illness and rechecked leucocyte counts while the patients were still ill, averaged 16,000 as compared to 17,000 on admission. In no instance did the leucocytes fall below 5,000 and almost without exception immature forms and toxic granulations decreased. One patient entered the hospital 3 days after an appendectomy for a perforated appendix. At the time of admission his temperature was 105, pulse 120, and he had classical signs of a generalized peritonitis. His white blood cells were only 5,000 and the differential blood count showed a marked leucemoid reaction, with 6 myeloblasts, 2 premyelocytes, 14 myelocytes, 11 juveniles, 13 band forms, 33 segmented forms, 11 lymphocytes, 8 questionable myeloblasts, and 2 unclassified cells. The leucocyte count rose steadily and the leucemoid reaction subsided following the administration of large doses of penicillin.

Oxygen was not used and distention was controlled, when necessary, by gastrointestinal intubation.

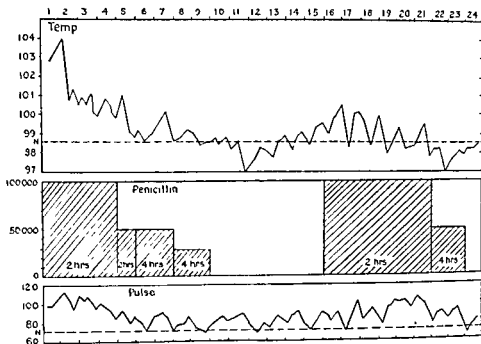


Fig. 3. Appendicitis of 2 days' duration. Appendectomy with finding of diffuse peritonitis. Peritonitis controlled with large doses of penicillin. Five days after penicillin was discontinued symptoms recurred and large mass, palpable by both rectal and abdominal examination, filled the pelvis. Second course of penicillin resulted in resolution of mass.

#### COURSE OF PERITONITIS

The course of the peritonitis in these 50 cases differed in several striking respects from that seen prior to the use of penicillin. The patients did not appear sick after the first 2 days. In no instance did the peritonitis appear to spread after the first 24 hours of treatment, and in all cases but one, definite clinical improvement had occurred by the fourth day. The abdomen lost its exquisite tenderness after the second day, and rigidity simultaneously disappeared. Distention was not often seen and ileus was minimized. Many of these patients did not vomit and were able to take a full liquid diet throughout the course of the disease. Most of them were alert, read magazines or newspapers, and did not seem to be uncomfortable.

**Temperature.** In no instance did the temperature or pulse rate rise higher after the first 2 days of treatment. In 50 per cent of the cases the temperature was normal by the end of the fifth day of treatment. The average febrile period for the entire group was 8 days before the temperature failed to rise over 99 for a 24 hour period. Nine patients ran a low-

grade fever, fluctuating from normal to 100 for over 10 days, and 1 patient remained febrile for 21 days. In the latter case a drain had been left in the pelvis and there was a profuse purulent drainage and wound infection, but the temperature did not rise over 100. A composite temperature chart of the first 21 cases treated with large doses of penicillin is depicted in Figure 2. The temperatures of the last 29 cases reached normal in exactly the same number of days as the first group, but their charts were not available for incorporation in the graph.

**Pulse rate.** One of the characteristic signs of uncontrolled peritonitis is an elevation of the pulse rate out of proportion to that of the temperature. Yet in this group the highest recorded pulse rate of the day had fallen below 100 by the third day (average) and in only 4 instances did the pulse rate remain over 100 longer than 1 week.

**Ileus.** Most patients with peritonitis experience considerable ileus, become distended, vomit, or put out large amounts of green or brown material by gastric suction. The majority in this group did not show signs of pro-

nounced ileus, or if they did so, it was only for a day or two. One explanation of this phenomenon is that penicillin controls the invasive qualities of the bacteria and minimizes the tendency to produce a paralytic type of ileus. This absence of cellulitis likewise may explain the rapidity with which the tenderness and rigidity of the abdomen subsides. The relatively slight amount of ileus and the consequently minimal loss of fluid and chlorides renders these patients easy to keep in fluid and chloride balance. Few alterations in blood chlorides were observed.

Despite the low incidence of paralytic ileus, true mechanical obstruction of the small bowel was fairly common. In 13 cases there was x-ray and clinical evidence of obstruction and in 12 of these 13 cases the obstruction was associated with the presence of a palpable mass. It is thus probable that the ileus was the result of mechanical obstruction in an inflammatory mass rather than secondary to the paralytic action of a generalized peritonitis. In every case the passage of a Miller-Abbott tube corrected the obstruction and in only 1 instance did it recur and require a second decompression.

**Masses.** During the acute stage of peritoneal irritation there is often so much rigidity that it is impossible to determine whether or not a mass is present. In only 8 cases was a definite mass palpable at the time the patient entered the hospital. But at one time or another during the course of the disease, 50 per cent of the patients developed intra-abdominal masses, 15 patients developed a pelvic mass palpable only by rectum and 10 developed masses easily palpable through the abdominal wall. All of these masses were located in the lower abdomen.

It has been estimated by Ochsner and Johnston that in cases of appendiceal peritonitis treated conservatively, three-fourths will subside spontaneously without going on to abscess formation (6). These authors state that in the remaining 25 per cent, incision and drainage of the abscess will be necessary. In this series of 50 patients, 26 were treated without appendectomy or drainage of an appendiceal abscess, 23 of these having had no operation and 3 having been merely explored.

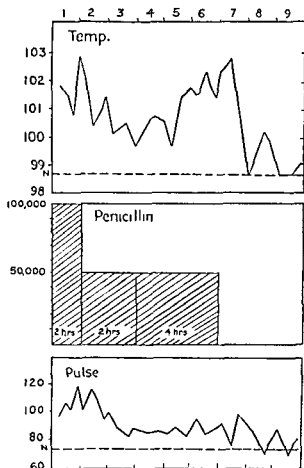


Fig 4. Secondary rise of temperature due to penicillin. Slow pulse and prompt return to normal of temperature curve occurred as soon as administration of penicillin was discontinued.

In 15 patients a mass developed, but under treatment with 100,000 units of penicillin every 2 hours, 4 to 8 days, they became afebrile and free of symptoms; the masses lost their tenderness, became smaller, and eventually disappeared. In no instance were incision and drainage necessary and insofar as it was able to be determined, there was no instance in which pus was discharged spontaneously into the bowel. In several patients, symptoms recurred after being once controlled, and the mass became larger after treatment with penicillin was discontinued, but in each a second course of treatment resulted in a second remission and eventually in complete resolution of the mass. Figure 3 depicts the temperature chart of a patient who required a second course of penicillin to control a pelvic mass.

Some of the masses were so large as to cause a visible asymmetrical deformity of the abdomen or to fill the pelvis so completely that on rectal examination the rectum appeared to

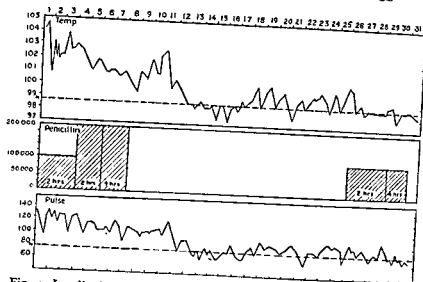


Fig. 5. Localized peritonitis with mass in right lower quadrant and pelvis. No operation. Patient apparently refractory to second course.

be occluded. In 2 instances fluctuation could be detected by rectal examination, and attempts were made to provide drainage by forcing a passage through the rectal wall. Unlike the usual pelvic abscess when such a passage is accomplished with ease, it was found that the tissues were not friable and that the wall of the rectum was so normal as to render difficult the passage of finger or instrument. The attempt was therefore abandoned, and the fluctuant area gradually disappeared and the mass resolved. Passage of pus was never detected.

Another remarkable finding about the masses is the absence of acute tenderness. They are sensitive to deep pressure, but when they are resolving they present few of the features of an appendiceal abscess. In the case of one man in his fifties, the absence of tenderness and the presence of a hard fixed mass in the right lower quadrant led to the suspicion that the peritonitis had originated from a carcinoma of the cecum. Subsequently, it was proved that the appendix was perforated.

In 7 cases, intra-abdominal masses developed following appendectomy. Rogers and Faxon encountered 40 such cases at the Massachusetts General Hospital. In 50 per cent of these patients the masses resolved spontaneously, 16 required abdominal drainage, and 4 required rectal puncture. Four pa-

tients died. None of the 7 patients in this series required drainage and all resolved spontaneously. In 1 or 2 instances other than these 7 cases there may have been spontaneous drainage of small amounts of pus from the abdominal cavity through the wound but it was not possible to tell whether the abscess was deep in the abdominal wall or superficially located in the peritoneal cavity. In any case, all definite intra-abdominal masses resolved spontaneously without surgical intervention.

*Infection of wounds.* The administration of penicillin may cause a slight reduction in the incidence of wound infection, but it will not prevent it. Thirty-six per cent of the wounds became infected, but in no instance did a severe infection develop. The remarkable thing about the wound infections was the absence of severe local or systemic reaction. Often they behaved like cold abscesses, pointed, became fluctuant, and discharged spontaneously without making themselves evident by pain, a significant febrile reaction, or redness or tenderness of the tissues surrounding the wound. In no instance was there extensive cellulitis. Provided no deep sinuses were present, the wounds healed with remarkable rapidity after the discharge of the pus.

*Side effects of penicillin.* Approximately 100 patients treated with 100,000 units of peni-

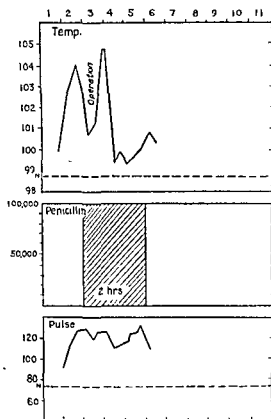


Fig. 6. Diffuse pelvic peritonitis due to perforation in carcinoma of sigmoid. Penicillin instilled in peritoneal cavity and given parenterally. Death by pulmonary embolism on third postoperative day. Autopsy showed no peritonitis.

cillin every 2 hours for varying lengths of time had no serious side effects. Urticaria is the most distressing symptom, but it is rare and seems to occur no more frequently with large than with small doses.

Fever may occur and it is characterized by elevation of the temperature without a corresponding elevation of the pulse rate or increase in the clinical manifestations of the disease (Fig. 4).

#### SUMMARY OF CLINICAL COURSE

The clinical course of peritonitis of appendiceal origin treated by large doses of penicillin given over a long period of time can be summarized as follows:

*1st and 2nd day.* No apparent change in the general condition of the patient. Peritonitis does not appear to spread.

*3rd day.* Improvement in patient's clinical condition; pulse and temperature are lower; patient feels better; ileus subsiding; abdomen less rigid and tender.

*4th day.* If the patient is not definitely improved it is likely that mechanical small intestinal obstruc-

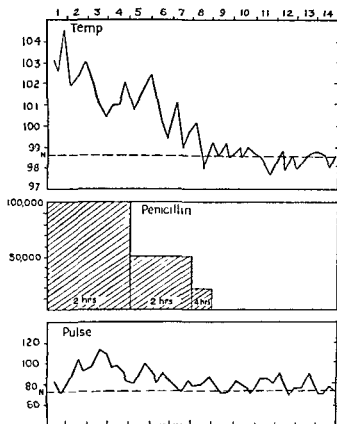


Fig. 7. Severe peritonitis. No operation.

tion is present. Roentgenogram of the abdomen should be made.

*5th and 6th day.* If there is no obstruction, patient is usually feeling well, eating a soft diet, and is alert and comfortable.

*7th day.* Occasionally intra-abdominal masses persist, but there is little fever and no symptoms.

*8th to 12th day.* If penicillin has been discontinued, signs of recrudescence of infection in abdominal abscesses should be looked for. A low-grade fever may be disregarded, but if it rises higher daily, or is accompanied by increasing pain, tenderness, or "gas pains," a second course of penicillin should be given.

Although this summary characterizes the course of the average case, an occasional resistant case will be encountered. If this occurs, one should not be discouraged but should continue treatment for 8 to 10 days. Eventually a response is usually obtained (Fig. 5).

*Results of treatment of peritonitis with penicillin.* In all of the 50 cases of proved peritonitis of appendiceal origin reported in this series the peritonitis has been controlled by the administration of penicillin. No intra-abdominal abscesses have drained spontaneously into the bowel or have required surgical



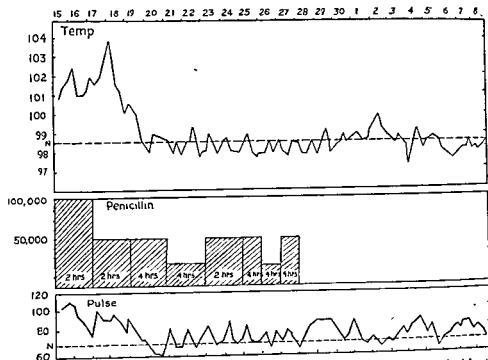


Fig. 8. Diffuse peritonitis. No operation. Large pelvic mass gradually absorbed without discharge of pus.

drainage. All intra-abdominal masses have eventually resolved, although several have required two or three courses of treatment. There have been no deaths as a direct result of peritonitis. The 1 death that occurred was due to thrombosis of the mesenteric veins, an indirect result of peritonitis which at the time of death was well controlled.

#### CASE REPORT

The patient was a young man who entered the hospital with a history of abdominal pain of 12 hours' duration. Abdomen was rigid enough to suggest the diagnosis of a perforated ulcer. Operation was performed immediately and what appeared to be a generalized purulent peritonitis was found. A culture showed *Bacillus proteus* and *Escherichia coli*. The appendix was perforated near its base.

Convalescence was uneventful for 3 days. The temperature fluctuated between 100 and 102, and the pulse rate remained elevated. On the third postoperative day the patient appeared a little better and the abdomen was somewhat softer. Later in the day his pulse became rapid and within a few hours it was imperceptible. The patient became delirious, then comatose, and despite supportive therapy, expired.

Postmortem examination revealed the general peritoneal cavity to be clean and glistening. An abscess approximately 1 inch in diameter containing thick white pus was present in the right iliac fossa

and a similar one was in the left. In the pelvis was another encapsulated abscess about 2 inches in diameter. The remainder of the peritoneal cavity was filled with an enormous amount of clear, blood-stained fluid, and the lumen of the small bowel was filled with this same material. Further examination revealed a diffuse thrombosis of the smaller mesenteric vessels. The remainder of the examination showed nothing remarkable.

This patient unquestionably died as the indirect result of peritonitis, but the localized and completely walled-off abscesses were not sufficient to have caused his death had he not developed a thrombosis of the mesenteric veins. This was the only fatality from appendicitis among the 900 patients operated upon in the past year.

Peritonitis secondary to perforating lesions of the large bowel appears to respond as readily to penicillin as does that due to appendicitis, provided of course that the contamination of the peritoneal cavity is controlled by exteriorizing or resecting the involved segment. Three patients with perforated carcinomas of the colon and one with a perforated diverticulitis of the colon have been operated upon and the involved bowel resected. In all cases from 12 to 36 hours had elapsed since the perforation and a diffuse purulent peritonitis was present. Yet in all cases the peritonitis was controlled. One patient expired as the result of a massive pulmonary embolism on the third postoperative day. A carcinoma of the sigmoid had perforated nearly 36 hours before. The pelvis contained several hundred centimeters of thick pus and the entire abdomen was rigid and gave

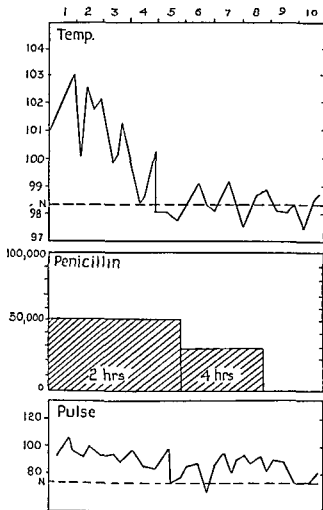


Fig. 9. Mass in right lower quadrant. No operation.

the appearance of a generalized peritonitis. The carcinoma was resected, the pus was aspirated from the pelvis, and 200,000 units of penicillin was placed in the peritoneal cavity. Two hundred thousand units was given intravenously and 100,000 units every 2 hours. On the third postoperative day, the temperature was between 99 and 100.5, the pulse between 100 and 130, and the abdomen was soft, flat, and not tender. The patient expired suddenly. Autopsy showed a massive pulmonary embolism, but aside from a little redness of the peritoneum, there was no evidence of peritonitis and no pus or fluid was present (Fig. 6).

In this series, the results of the management of appendiceal peritonitis have been much the same whether immediate operation was performed or whether the peritonitis was managed conservatively. In each case the average length of time before the temperature fell to normal was 8 days. Masses were palpable more frequently in the patients whose appendices were not removed. Mechanical intestinal obstruction, associated with the masses, occurred more frequently in the group not operated upon.

In the group operated upon, on the other hand, the patients appeared somewhat sicker, and experienced a more profound toxic reaction from the peritonitis.

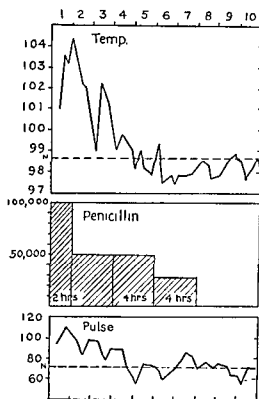


Fig. 10. Abdomen explored. Abscess found but not disturbed. Appendix not removed.

The only death that occurred was in the operated upon group. Since intestinal obstruction of inflammatory origin is easily corrected by decompression with a Miller-Abbott tube, and since little can be done to combat the overwhelming toxemia incident to operation performed in the face of a fulminating peritonitis, it is my impression that conservative treatment is the safer method of dealing with seriously ill patients. In most cases, and especially when the general condition of the patient is good and sufficient penicillin is given to control the peritonitis, there is little to choose between the two methods of treatment (Figs. 7 to 12).

#### EVALUATION OF STUDY

There is strong evidence that peritonitis of appendiceal origin in both man and dog can be controlled by large doses of penicillin given over a long period of time. There is also evidence that penicillin levels of the blood are proportional to the amounts given intramuscularly and that the drug is present in ascitic fluid in about the same concentration as in the blood. Yet penicillin in concentration up to 20 units per centimeter does not inhibit the growth of *Escherichia coli* (1). *Escherichia coli* and other penicillin resistant organisms are almost always found in the cultures taken from patients with appendiceal peritonitis.

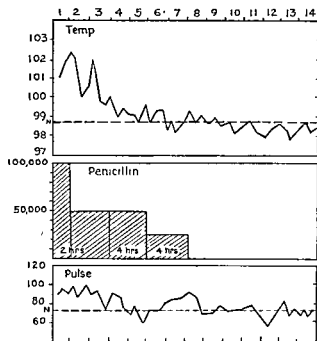


Fig. 11. Appendiceal abscess drained but appendix not removed.

How can it be explained that peritonitis due to mixed infections is controlled by concentrations of penicillin less than  $1/10$  of the minimum level required to inhibit the growth of *Escherichia coli*, the predominant organism in the infection? And why is it that whereas in most infections the results of chemotherapy are prompt and dramatic, manifesting themselves within 24 hours of the initiation of treatment, in the treatment of peritonitis the results become apparent slowly? And, finally, why is it that four or five times the usual effective dose of penicillin is required to obtain a satisfactory result?

These questions can best be answered in the light of Altemeier's studies. Altemeier has shown that cultures of *Escherichia coli* or of *Bacillus pyocyaneus* have the property of destroying the activity of penicillin. If a known amount of penicillin is incubated with a culture of *Escherichia coli*, 98 per cent of the activity of the penicillin is destroyed in 12 hours.

This ability of *Escherichia coli* to destroy the activity of penicillin could well account for the fact that large doses of penicillin are required to control the gram positive cocci when they are growing in a mixed infection and are

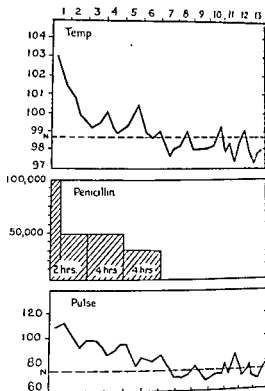


Fig. 12. Appendiceal abscess ruptured at operation. Appendix removed.

associated with *Escherichia coli*. It also explains why it takes several days and large amounts of penicillin to control infections due to a mixture of *Escherichia coli* and gram positive cocci. By giving enough penicillin over a long period of time eventually more penicillin is given than the *Escherichia coli* can destroy, and finally there is built up a sufficient concentration of active penicillin to inhibit the growth of the virulent cocci.

Although it can now be seen how it is possible for large doses of penicillin given over a long period of time to inhibit the gram positive cocci, there is still no explanation as to why penicillin, in concentrations insufficient to inhibit *Escherichia coli*, eventually results in control of infections in which this organism predominates. It is possible that *Escherichia coli*, in pure culture, is not a pathogenic organism, but is in reality a mere saprophyte. If this were the case one need not rely on chemotherapy to control it, as the normal defense mechanisms of the body would be able to deal with it once the gram positive cocci were inhibited. The absence of cellulitis around the

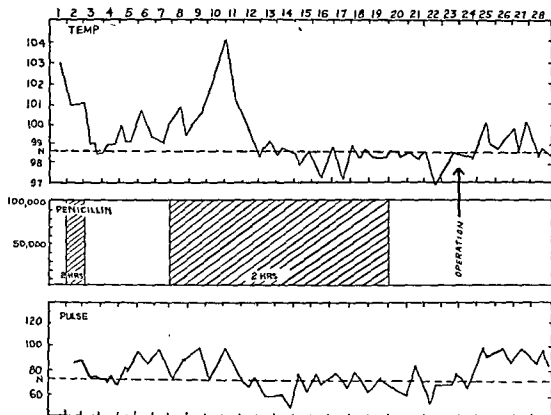


Fig. 13. Acute appendicitis. Patient received 100,000 units of penicillin every 2 hours for 1 day. Penicillin then discontinued and within 5 days there was recurrence of signs and symptoms of localized peritonitis. Second course of penicillin then given over a period of 12 days. Temperature again fell to normal and signs of peritonitis disappeared. Ten days after patient had become afebrile, operation was performed and abscess containing several ounces of foul pus with *Escherichia coli* odor was found. Since systemic reaction had subsided and the mass was steadily decreasing in size, it is probable that this mass would have been absorbed spontaneously without surgical drainage.

infected wounds of patients receiving large doses of penicillin, the absence of tenderness of large intra-abdominal masses, the absence of friability of the tissues overlying these masses, the absence of paralytic ileus in the face of diffuse peritonitis when adequate doses of penicillin have been given for a few days, all of these findings and the frequent observation that the temperature may be normal and the patient may feel well in the presence of a large intra-abdominal mass, point to the fact that it is not *Escherichia coli* but the gram positive cocci that are the chief offenders in peritonitis. If the cocci are controlled, the peritonitis is controlled and the marvelous defensive and absorptive mechanism of the peritoneum is able to take care of the saprophytic or weakly pathogenic *Escherichia coli* infection.

In wounds, the defensive and absorptive action of the peritoneum is not available and, moreover, there is suture material, strangulated tissue, serum, and blood, in which

*Escherichia coli* can grow. Even if it does not invade and cause a cellulitis, a wound infection of low virulence is apt to develop. Instead of being absorbed, as it might be in the peritoneal cavity, eventually it drains. This explains the persistence of a normal expectancy of wound infections despite treatment with penicillin.

In only 1 case in this series was an inflammatory mass opened while it was still palpable. This patient had had 100,000 units of penicillin for 6 days and had been afebrile for 11 days. He had no symptoms, but a mass was still palpable. An interval appendectomy was advised and at operation, 4 or 5 ounces of foul, fecal-smelling pus was obtained and the general peritoneal cavity was extensively contaminated. Yet there was little systemic reaction and the temperature did not rise over 100. Unfortunately, no culture was taken, but despite the fact that *Escherichia coli* must once have been present to produce

Units of penicillin per c. c. of medium.		10	5	2.5	1.25	0.625	0.312	0.156	0.078	0.039	0.019	0.0097	0
Pure culture <i>Staphylococcus aureus</i>		-	-	-	-	-	-	-	-	-	+++	+++	+++
Mixed culture	<i>Staphylococcus aureus</i>	-	-	-	-	-	-	+	+	++	++	+++	+++
	<i>Escherichia coli</i>	+++	+++	+++	+++	+++	+++	+++	+++	++	++	+	+

the odor, the patient had no systemic reaction and the mass was becoming smaller each day and probably would have resolved spontaneously (Fig. 13). If sufficient penicillin is given to destroy the gram positive cocci, it would appear that the peritoneum can take care of the rest.

#### SUMMARY AND CONCLUSIONS

1. A group of 50 patients with proved appendiceal peritonitis treated by the administration of 100,000 units of penicillin every 2 hours for several days is reported.

2. There was but 1 death in this series and this did not occur as the direct result of peritonitis but from thrombosis of the mesenteric vessels.

3. In all cases of spreading peritonitis, the infection was controlled by penicillin.

4. In all cases of localized peritonitis with or without formation of a mass, the infection was controlled and the mass eventually was absorbed.

5. In no case was it necessary to drain an intra-abdominal abscess and so far as is known, there was no spontaneous drainage into the bowel.

6. It is suggested that the mechanism of action of large doses of penicillin in mixed infections is against the virulent gram positive cocci. *Escherichia coli* is known to inactivate penicillin, hence large doses of penicillin must be given for long periods of time if effective action against the cocci is to be obtained.

7. It is further suggested that *Escherichia coli* in pure culture usually is of low virulence and that if the virulent gram positive cocci are controlled by chemotherapy, the peritoneum is able to localize and eventually absorb infections due to the remaining *Escherichia coli*.

NOTE.—To check the *in vitro* resistance of mixed cultures to penicillin, a heavily seeded 18 hour agar slant of staphylococci Strain N.R. RL 209 was washed with a 6 hour broth culture of *Escherichia coli*. This was diluted to make a faintly turbid suspension and 0.01 cubic centimeter of this was used as the inoculum.

After 24 hours' incubation at 37 degrees smears were made of all tubes and stained by Gram's method (see table). It is apparent that concentrations of penicillin of 0.039 unit per cubic centimeter inhibited the staphylococcus in pure culture, but that concentrations of 0.312 unit per cubic centimeter were required to inhibit the staphylococcus in the presence of *Escherichia coli*. The bacteriology was conducted by Mr. Alfred Reich of the Cleveland Clinic.

The above figures indicate that approximately 8 times as much penicillin is required to control staphylococci in mixed culture without *Escherichia coli* as when the staphylococcus is in pure culture. This figure corresponds quite accurately with the increased dosage required to control mixed infections as compared with infections caused by gram positive cocci in pure culture.

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## TORSION OF THE SPERMATIC CORD

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**T**ORSION of the spermatic cord has been discussed and reported in the medical literature since 1840. Delasiauve described the first clinic case. In May, 1944, Ewert and Hoffman stated that the literature including June, 1943, revealed 489 cases of spermatic cord torsion. Many cases of torsion diagnosed at operation are never reported. Many cases in which operation is not done remain undiagnosed and the result is aseptic necrosis and late atrophy. The literature indicates that this urological emergency is still not recognized sufficiently early to save many of these testes by surgical intervention. In 80 reported cases 64 (80 per cent) had been operated upon and in only 15 (23.5 per cent) could the testis be saved by detorsion. In 49, or 76.5 per cent, of the cases orchiectomy had to be performed for testicular aseptic necrosis. The remaining 16 (20 per cent) cases showed that 5 had spontaneously reduced themselves; in 3 the detorsion was accomplished by the patient; in 5 immediate surgery was refused and later follow-up showed complete atrophy; in 3 others the diagnosis of torsion can well be questioned.

### ETIOLOGY

A great deal has been written about the etiology of torsion, but some factors still remain obscure. In the absence of trauma there exists a congenital anomaly which predisposes to acute or recurrent torsion. Torsion of the spermatic chord may occur outside of the tunica vaginalis (extravaginal) or inside of the tunica vaginalis (intravaginal). Extravaginal torsion occurs more readily in undescended testes in the presence of trauma and is much less common. Lowsley and others deny the occurrence of extravaginal torsion and accept the only case reported by Taylor in 1897. The only intravaginal type of torsion is most common

and may occur in undescended and descended testes alike. Existing anomalies predisposing to intravaginal torsion are: imperfect descent, absent or long mesorchium, absent or long gubernaculum, high investment of the tunica vaginalis, intravaginal insertion of cremasteric muscle, and redundant scrotum. In addition, the vascular pedicle does not enter the testis through the body but rather through the upper pole. With such an anomalous "cherry stem" vascular pedicle, an absent mesorchium and high investment of the tunica, we have a perfect anlage for intravaginal torsion of the spermatic cord. Muschat has demonstrated cremasteric fibers inside of the tunica vaginalis which he believes under the right conditions are responsible for torsion. Indirect muscular exertion and trauma frequently precede torsion. There are other cases, however, such as those occurring during sleep, in which the exciting factor still remains obscure. The scrotal structure which precipitates torsion is the contraction or segmental contraction of the cremasteric muscle.

This condition may occur at any age; Hegner and Postma and Langley reported inguinal torsion in 4 months old infants and O'Connor reported one in a man 68. The majority occur before the 20th year. O'Connor in 124 cases found the average 13.3 years, and Abeshouse in 350 cases the average age 17.7 years. Clute states that 47 per cent occur between the ages of 15 and 25. Ewert and Abeshouse report that the right and left sides are equally involved. Twenty-six cases of bilateral spermatic cord torsions have been recorded. Scudder reported that about one-half (47 per cent) occur in undescended testes.

### SYMPTOMS

The history of acute excruciating pain in the testis of a patient who has unassociated urinary tract infection should lead us to suspect an acute torsion of the cord. While the

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acute pain may follow any type of muscular effort or exertion, it can awaken a patient out of a sound sleep. Patients may become nauseated, vomit, and observe rather soon a sudden swelling of the involved testicle. The pain may be most severe during the first 24 hours and after 48 to 72 hours it will spontaneously begin to subside. When the testis is in the groin or within the abdomen the corresponding thigh may be held in the semiflexed position. In the presence of urinary tract infection or gonorrhea, the diagnosis of acute torsion becomes exceedingly difficult.

Before the age of 20, a history of recurrent pain in one or both testes, in the absence of infection, should lead us to suspect chronic recurrent torsion in every patient.

## PHYSICAL FINDINGS

The physical findings in the acute and chronic cases are quite dissimilar. In acute cases there is an early swelling, edema, and tenderness involving the affected scrotal sac. Prehn in 1937 noted in acute epididymitis that elevation of the testis would tend to relieve the pain while in acute torsion the pain was always aggravated (Prehn's sign.) Also Ownby and Atkinson in 1942 emphasized the early edema and fixation of the scrotal contents to the adjacent coverings. They stated that when present Dr. James Dillon had repeatedly called their attention to this valuable diagnostic aid (Dillon's sign.) Often the testicle will be elevated but due to the edema it is impossible to differentiate the testicle from the epididymis. The cord above the testicle is usually enlarged. In the absence of infection there are usually no additional urologic abnormal physical findings. The white blood count may be elevated even as high as 20,000. The pulse and temperature usually are normal. In neglected cases of spermatic cord torsion there may be still some enlargement but the outstanding findings are the rubbery, firm, smooth, testicular consistency with elevation and retraction of the testis against the external inguinal ring (Fig. 1). In late cases the testes become smaller and asymptomatic, finally ending in complete atrophy. The epididymis is usually involved and causes the irregularities noted on palpation.

## DIAGNOSIS

The diagnosis in many instances should be suspected from the history. Many patients give a history of recurrent testicular pain and swelling. The findings of acute swelling following sudden pain in the testis and with all other examinations negative, strongly suggest torsion of the spermatic cord. It is usually impossible to differentiate between the epididymis and testicle in acute cases. When present Prehn's and Dillon's signs may be helpful. It is of extreme importance to make an early diagnosis if the testicle is to be saved.

## DIFFERENTIAL DIAGNOSIS

*Acute epididymitis.* Acute epididymitis in many ways may so simulate acute torsion that a differential diagnosis becomes extremely difficult. In the presence of urethral discharge, pyuria, prostatovesiculitis or a recent history of neisserian infection, acute epididymitis would seem more likely. With acute vasitis and funiculitis, palpation of the inguinal cord will reveal more tenderness than is found in most cases of torsion. Prehn's sign should be negative in epididymitis. McKay reported an acute torsion in the presence of a positive smear. A patient with acute epididymitis usually runs some fever with a moderate elevation of the white blood count.

*Strangulated hernia.* The symptomatology of acute strangulated hernia may be very similar to acute torsion of an inguinal testicle. The pain may be identical but the gastrointestinal symptoms will be less severe in torsion. Painful inguinal masses and swellings occurring in patients with undescended testes should make us suspect acute torsion. While the differential diagnosis may be most difficult in some cases, early surgical exploration is indicated in either case.

*Torsion of the appendix testis.* Torsion of the appendix testis occurs when this embryonal rest is pedunculated and becomes strangulated. Sudden severe pain may occur, but usually there is less swelling, edema, or testicular fixation. Palpation will reveal localized exquisite tenderness over the strangulated appendix testis.

*Acute orchitis.* Acute orchitis may follow or precede mumps or complicate a surgical



Fig 2. Case 2. The remaining testis in recurrent bilateral torsion is sutured with interrupted silk to the dependent scrotal fascia.

vascular constriction. In a patient in whom the artery as well as the vein has been suddenly occluded, the viability will be shorter than if only the vein is primarily occluded. While manual detorsion is always possible without surgery, the technique is unsafe and should be discarded. Surgical detorsion should always be followed by orchidopexy to preclude subsequent attacks. Ormond's case of a physician who practices manual detorsion for 12 years without testicular atrophy is an exception rather than the rule. Apparently this was a recurrent partial venous occlusion which could be satisfactorily reduced. Cahen operated upon a patient 12 hours after occlusion, found testicular gangrene necessitating orchidectomy. The practice of applying hot formication after detorsion is a good index of testicular viability. Surgical intervention within 12 hours will save the majority of acute torsions, but Birdsall states "in the majority of cases in which the diagnosis has been made early and the testicle found to be viable and detorsion performed, the testicle has undergone atrophy." Occasionally the strangulated tissue becomes infected resulting in gangrene.

In chronic recurrent cases the simple fixation of the lower pole of the testis to the dependent tunica vaginalis (Fig. 2) and fasciae will obviate subsequent acute attacks and gangrene. In all bilateral cases, the mate should be treated by fixation. Campbell has used the Jaboulay operation for the fixation of the opposite testis. In this technique the tunica vaginalis is everted to prevent a hydrocele, and the testis is anchored to the scrotum.

#### CASE REPORTS

CASE 1. R.B., aged 20 years, while home on an overseas furlough on April 9, 1943, was suddenly seized during sleep with severe pain in the left testis.

testicle with re-  
ends upon the amount





Fig. 3. Case 1. R.B., aged 20 years, shows  $1\frac{1}{2}$  clockwise turns to left producing aseptic gangrene of the testis. This patient went through several Southwest Pacific campaigns but not until he arrived home on an overseas furlough did he experience an acute torsion of the spermatic cord.

Within 2 hours the testis began to swell and a local physician was called. He admitted several recent sex exposures but denied any evidence of urethral discharge or history of venereal disease. A diagnosis of gonorrheal epididymitis was made and he was treated unsuccessfully with oral sulfonamides. On admission to Bushnell on May 9, 1945, examination revealed a slightly enlarged, firm, left testis and epididymis. The testis compared to the right seemed somewhat fixed within the upper scrotum. The remainder of the physical examination, x-rays, and laboratory tests were negative and noncontributory. A diagnosis of suppurative epididymitis was made and exploration on May 19, 1945, revealed marked peritesticular adhesions making delivery difficult. The mobilized testis was firm and irregular. The tunica vaginalis was opened and an intravaginal twist of  $1\frac{1}{2}$  clockwise turns was noted at the upper pole (Fig. 3). The tunica vaginalis was pale, fibrous, and slightly adherent to the tunica albuginea. Incision of the testis revealed testicular necrosis and a hemorrhagic distended epididymis. There was no bleeding. Removal of the cord and testis was carried out. The pathologic report showed aseptic necrosis and hemorrhage involving the entire testis and epididymis (Fig. 4). Following recovery patient was returned to duty.

It is interesting that this patient was fortunate to go through many front line battles unscathed and while at home in bed on an overseas furlough he suffered an acute undiagnosed lesion resulting in loss of one testis.



Fig. 4. Case 1. Microscopic section, torsion of the spermatic cord showing chronic inflammation, fibrosis, and an old hemorrhage into the tunica and superficial portion of the testis. Acute infarction of the testicular substance

CASE 2. C.M., aged 22 years, gave a history of testicular injury at the age of 8 years. For the past 14 years he has had recurrent attacks of pain in each testicle, each attack lasting for 1 to 4 days. At 9:30 a.m. on July 1, 1943, he developed acute pain in the left testis. Later he developed pain in the left abdomen and swelling of the testicle. He was admitted to the station hospital and given morphine for persistent pain. After 4 weeks of symptomatic treatment he was transferred and admitted to Bushnell on July 28, 1943, with a diagnosis of orchitis. Examination revealed the right testis and epididymis to be normal. The left was enlarged  $1\frac{1}{2}$  times, hard, smooth, but not tender. There was slight enlargement of the left vas deferens and a small palpable nodule over the left pubic bone. The prostate and seminal vesicles were normal. The abdomen revealed no abnormalities, but was sensitive to deep palpation in the left lower quadrant. X-ray studies of the urinary tract, chest, and scrotum revealed no abnormalities. The blood count, urinalysis, and serology were within normal limits. The prolan A test of the morning specimen of urine was negative. Diagnoses of chronic torsion of the left spermatic cord with necrosis and chronic right recurrent torsion of the right spermatic cord were made. On August 11, 1943, under spinal anesthesia, the left testicle was delivered through a low left inguinal incision. Marked fibrous adhesions were noted surrounding the testicular coverings. The tunica vaginalis was yellowish-green and adherent to the tunica albuginea (Fig. 5). Upon dissection it was noted that the superior pole of the testicle presented a small, twisted, avascular pedicle with  $1\frac{1}{2}$  clockwise turns. The testicle was incised and there was no bleeding. The parenchyma was soft, putty-like, with a brown color. The left inguinal cord and testis were removed. The most dependent portion of the right scrotal sac was incised so as to include the tunica vaginalis. The exposed albuginea was sutured to the vaginalis and scrotal fascia with interrupted black silk (Fig. 2). Both incisions were closed with silk without drainage. The patient made an uneventful recovery and was returned to full military duty.

Case of bilateral chronic recurrent torsion for 14 years which finally resulted in the loss of one testis. Bilateral orchidopexy should have been carried out many years before.

CASE 3. J.J., aged 23 years, 2 hours following sexual intercourse with an Alaskan Eskimo developed severe pain and swelling of the right testicle. In the hospital he was treated for acute epididymitis with oral sulfonamides. The swelling and soreness subsided after 18 days, but some induration remained. He remained well for  $1\frac{1}{2}$  years and in December, 1943, the tenderness and swelling recurred. He was again treated in the hospital for acute epididymitis. After 26 days, the swelling again subsided, but the right testis remained firmer than

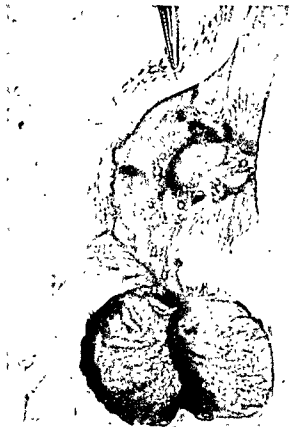


Fig. 5. Case 2 C.M., aged 22 years, aseptic necrosis of the left testis 6 weeks after acute torsion showing avascular dark brown putty-like testicular parenchyma.

the left. He was returned to the continental United States with a diagnosis of neoplasm. On April 10, 1944, he was transferred to Bushnell. Examination of the urinary tract was entirely negative and the findings were limited to the scrotum. The right testis was smaller than its fellow and appeared rubbery hard and retracted into the external ring (Fig. 1). The left testis and epididymis were normal. The prostate and its secretion were normal, the urine was grossly clear. Laboratory examination of the urine, blood, and serology revealed no abnormalities. The prolan A test of the morning urine was negative. Preoperative diagnosis of chronic torsion of the right spermatic cord was made. On April 14, 1944 under local anesthesia, the right inguinal cord and upper scrotum were exposed. The testicular coverings were markedly adherent making delivery of the testis difficult. The testicle was small and rubbery in consistency with a firm area on the superior anterior pole representing the epididymis. The tunica vaginalis was very adherent and thin. Incision of the tunica albuginea revealed a greenish appearing testicle with a "cherry stem-like" pedicle. The pedicle above the upper pole had one complete counterclockwise turn, occluding the testicular blood supply. The cord was doubly clamped, ligated, and removed with the testis. Pathological examination showed a torsion of the spermatic cord with chronic inflamma-



Fig. 6 Case 3. Four months after acute torsion of the right spermatic cord the testis was small and on section showed an avascular greenish appearing parenchyma with a "cherry stem-like" pedicle.

tion and infarction of the right testicle and epididymis. Patient was returned to duty.

The sudden onset of acute testicular pain 2 hours following intercourse, in the absence of infection, should have suggested an acute torsion and immediate surgery.

**CASE 4.** M.J., aged 22 years, in October, 1944, received a gunshot wound injuring the spinal cord at the level of sixth dorsal vertebra, resulting in immediate paralysis below that level. He received symptomatic treatment, and tidal drainage was begun with an indwelling urethral catheter. He was admitted to Bushnell on January 2, 1945, with a diagnosis of transverse myelitis, resulting in complete bowel, bladder, and leg paralysis. This patient was seen by the urologic service the first time on the day of admission and a well functioning urethral catheter was noted. The urine was cloudy and the original cultures showed diphtheroids, proteus, and Gram positive cocci unidentified. The cystometrogram made on February 2, 1945, showed a capacity of 450 cubic centimeters and a maximum voluntary pressure of 86 centimeters of water. On March 30, 1945, many bladder concretions were removed through a panendoscopic sheath. On May 26, 1945, he was seen again on account of swelling of the left scrotal sac. The left scrotal sac was red, swollen, but only slightly tender. The left vas deferens seemed indurated above the swelling. The indwelling catheter and tidal drainage were working well. Acute nonvenereal epididymitis was diagnosed and sulfadiazine, 1 gram four times daily, and penicillin 25,000 units, every 3 hours were initiated. This treatment was continued for 15 days without noticeable improvement. On June 13, 1945, an exploration of the left scrotal contents was carried out under intravenous pentothal anesthesia. The testis was delivered with difficulty due to fibrous adhesions involv-

ing all the structures around the left testicle. With sharp dissection, the testis was delivered and opening of the tunica vaginalis showed aseptic necrosis. The vascular pedicle was anomalous, twisted 3/4 clockwise turn and attached to the upper pole of the testis. The entire mass including the left spermatic cord was removed. The microscopic sections showed old and recent thrombi involving arteries and veins of the spermatic cord with aseptic necrosis of the left testis and epididymis. The wound healed *per primam*. The right testicle has remained normal.

This patient has a complete paraplegia, but contractions of the cremasteric muscle are preserved and occur while the patient has "abdominal spasms." This is the first recorded case of torsion occurring in a total paraplegia and suggests segmental cremasteric contractions. Acute torsion was not considered in the differential diagnosis on the first visit.

**CASE 5.** H.B., Negro, aged 20 years, had swelling and pain in the left scrotal sac in 1941 which lasted for 1 day. He had a similar attack in 1942 while walking to work. An attack of acute gonorrhea in 1943 was cleared in 2 weeks without complications. While lying down on an island overseas on May 20, 1945, he experienced an acute excruciating pain in the left scrotal sac followed by swelling. He was admitted to the station hospital and treatment for acute epididymitis was begun. He failed to improve and was transferred to Hawaii and admitted to the 318th General Hospital on June 8, 1945. Admission examination revealed the left testis three times the size of the right, smooth, firm, and what seemed to be an indurated epididymis. The skin overlying the left scrotal contents was definitely adherent anteriorly. Intravenous pyelograms and chest film were normal. The urine was clear and negative for tubercle bacilli. The tuberculin skin test showed 1+ positive. The administration of 200,000 units of penicillin failed to reduce the swelling. Chronic torsion was now suspected. On July 5, 1945, exploration of the left scrotal contents revealed marked peritesticular adhesions, intravaginal torsion 3/4 counterclockwise turn, "cherry stem" vascular pedicle and yellow-green tunicae. Incision of the testis showed no bleeding. The testicle and cord were removed. The microscopic sections showed complete aseptic necrosis of the testicle and epididymis due to spermatic cord torsion. Following the operative recovery was uneventful.

Acute torsion occurring in a soldier under fire resulting in an improper immediate diagnosis, neglect, and loss of one testicle. The correct diagnosis should have been suspected from the history (C.J.S.).

## SUMMARY

An anomaly of the testicular attachments and the vascular pedicle is necessary for torsion of the cord to take place. The precipitating factors are the intravaginal and extravaginal fibers of the cremasteric muscle. Muschat has shown that, when the tunica vaginalis abnormally invests and encircles the entire epididymis, the testis and epididymis will not be attached to the scrotal wall. In these cases the testicular blood supply enters the upper pole. A polar pedicle with a high investment and a relaxed tunica is an ideal anomaly for an acute torsion. Why and how the contractions of the cremasteric muscles are initiated is still not well understood. It is understandable how muscular effort, direct or indirect, may influence its contractions but it is less understandable when torsion occurs during periods of physical relaxation or sleep.

It is of unusual interest to note the case of acute torsion in complete transverse myelitis (Case 4). Segmental cremasteric muscle contractions of the lateral and median fibers may be observed in this patient's scrotum. In the presence of an anomalous testicular pedicle unco-ordinated segmental spasms and contractions of the cremasteric muscles could readily precipitate and maintain an acute spermatic cord torsion until tissue edema and swelling supervene. Goodrich suggested the counterspin of the testis was an important factor in acute torsion. This seems, in part, to be the *modus operandi*, as only a few cases undergo spontaneous detorsion. In cases of mild recurrent torsion there is only sufficient testicular mobility to cause passive congestion and pain. These mild cases may reduce themselves or are reduced by the patient.

The record in the management of spermatic cord torsion leaves much to be desired. The early signs and symptoms are still unrecognized and ignored. Masterly inaction instead of immediate surgery still results in the loss of 75 per cent of the testicles in patients operated upon late. If in the differential diagnosis of every inguinal and scrotal swelling characterized by severe sudden pain, torsion were considered, many more cases would be diagnosed early. The history itself many times suggests the correct diagnosis. Acute testicu-

lar pain following any conceivable type of muscular exertion, work or play, should forever raise the question of torsion in the examiner's mind. Torsion occurring during sleep should be more widely recognized and followed by prompt surgical exploration. In all fairness, the fault is not always on the side of medical attendants. Parents and patients refuse early surgery in approximately 15 per cent of cases.

Many testicles could be saved if we would explore a few cases of acute epididymitis for a mistaken torsion rather than treat the majority of acute torsions conservatively as epididymitis. Acute epididymitis treated surgically usually recovers while torsion treated by inaction and conservatism will result in fibrosis and complete testicular atrophy.

## CONCLUSIONS

1. Acute torsion of the spermatic cord is frequently undiagnosed, and after its occurrence only 1 in 5 testes are saved.

2. Intravaginal torsion in descended testicle occurs when an anomaly of the testicular attachments and pedicle is present, precipitated by segmental contraction of the cremasteric muscle.

3. Chronic torsions of the spermatic cord should be anchored surgically to the dependent scrotum before the acute emergency occurs.

4. Acute torsion operated upon immediately or within 8 hours will usually result in a viable organ.

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# EXPERIMENTAL STUDY ON LIVER FUNCTION TESTS

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THERE is at present a tendency to perform simultaneously several tests of liver function and to repeat them during the course of an illness since this is the only way of obtaining fairly accurate data concerning the functional state of the organ. This tendency, perfectly justified by the studies of experimental hepatic pathology and recently confirmed by studies with patients (24, 25, 26, 28, 30, 35), is based on the following facts:

1. The liver is characterized by its multiple functional activities and these may be variously affected by a certain type of lesion. Thus "the employment of a number of tests in different phases of the disease will lead to a satisfactory appraisal of the physiologic status of the organ" (23).

2. "The hepatic function varies not only from day to day but from hour to hour" (Ivy). In this statement are implied the concepts of duration of illness and of hepatic regeneration. The time element (duration of illness) is important as regards hepatic regeneration. The liver's great capacity for regeneration is a factor that limits the use of liver function tests. "Unless the hepatic injury be extensive and rapid the simultaneous incidence of regenerative processes can compensate and overshadow the destructive effect of the pathological processes" (21). We were able to confirm this assertion (4, 5).

3. A close interrelation exists among the intrahepatic and extrahepatic (biliary tract) pathological processes. Snell and Magath pointed out accurately that clinically a gross extrahepatic biliary obstruction does not exist without injury of the hepatic parenchyma, nor a pure form of jaundice without injury or obstruction of the finer bile ducts or canaliculi. This fact must be taken into account when the purpose of liver function tests is that of ob-

taining data for the differential diagnosis of jaundice.

As Ivy (21) has pointed out, the purposes of performing liver function tests can be summarized in three main objectives: (a) to establish whether or not a hepatic disturbance exists, (b) to establish a prognosis of the disturbance and to aid in determining the surgical risk, (c) to determine the differential diagnosis of jaundice.

Drill and Ivy (14) made a comparative experimental study of five liver function tests. They used dogs to which they administered twice a week small doses of carbontetrachloride, a hepatotoxic drug. The purpose of their study was to investigate the comparative sensitivity of the tests in three respects: (a) capacity to discover the hepatic damage, (b) continued validity of the tests as the administration of carbontetrachloride was prolonged, and as well (c) the existence of association or dissociation among the several liver function tests.

With an almost similar purpose we, coincidentally and independently, have made a comparative experimental study of the prothrombin concentration of plasma, the bilirubinemia, and the acid and alkaline phosphatase activity of the serum of dogs in which different degrees of hepatic damage were produced: (a) by chloroform anesthesia, (b) by cholecystectomy and ligation of the common duct, and (c) by cholecystectomy. Cholecystectomy alone was chosen as a procedure that produces, in dogs, modifications of the phosphatasemia not attributable merely to a post-operative reaction but apparently due to a determined though slight degree of biliary insufficiency (12).

## METHODS

1. *Chloroform anesthesia.* Normal dogs which had been fasted for 3 days (water ad libitum) were used. They were subjected to a

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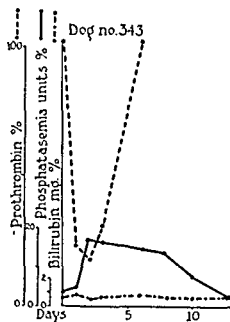


Chart 1.

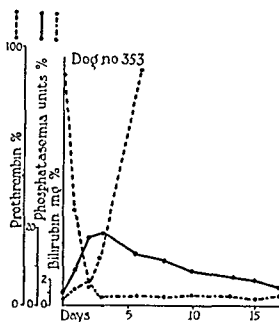


Chart 2.

according to the average of results obtained from normal dogs.

## RESULTS

1. *Chloroform anesthesia.* From Table I and Charts 1 and 2 it can be seen that:

a. Increase in alkaline phosphatase and decrease in prothrombinemia are more sensitive indices than is bilirubinemia in detecting the hepatic damage produced by chloroform anesthesia.

b. Hypoprothrombinemia is an earlier index of hepatic damage than is hyperphosphatasemia. It reaches its maximum during the 24 to 48 hours following the anesthesia while the highest value of the phosphatasemia is recorded between 48 and 120 hours following the anesthesia.

c. At the 5th day (or at most, the 6th) the prothrombinemia has reverted to its normal value while the phosphatasemia remains above the normal level until the 10th to the 13th day.

d. The value of the bilirubinemia is not greatly modified, ascending slightly and reaching its maximum between 24 and 48 hours, and then reverting to normal. Compared with prothrombinemia, bilirubinemia gives no information regarding the severity of damage.

2. *Cholecystectomy and ligation of the common duct.* Tables II and III, and Charts 3, 4, and 5 show that:

a. The increase in serum alkaline phosphatase is greater than that in the experiments of chloroform intoxication (one hundred and fifty times the normal initial level). Fifteen hours after operation the increase is very pronounced, but the maximum value is reached at some point between the 4th and 94th day. Then an irregular and constant decline begins which lasts until the death of the animal. This decrease may reach a value smaller than the initial increase, but is always above the normal level.

b. The acid phosphatase activity parallels the alkaline but to a lesser extent. This increase is slightly greater than in the case of chloroform intoxication.

c. Bilirubin increases after the ligation of the common duct. The maximum concentration is obtained between the 4th and the 52d day following operation. Afterward it stabilizes at a level slightly above the normal. In one experiment (Dog 375, Chart 5) a sudden decrease to a 0 level can be observed. The autopsy findings revealed a spontaneous rupture of the biliary passages.

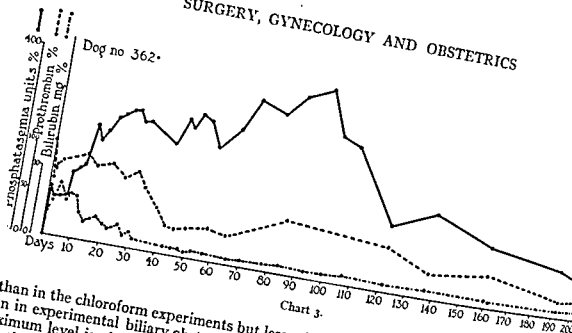
d. Prothrombinemia is late in revealing hepatic damage due to obstruction; only at the final period of the experiment is its value consistently low.

3. *Cholecystectomy.* Table IV shows:

a. The alkaline phosphatase increases in the cholecystectomized dogs; the increase is great-



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er than in the chloroform experiments but less than in experimental biliary obstruction. The maximum level is observed between the 10th and the 16th day following operation. After this period a decline begins and the normal level is reached at the end of the 50th day.

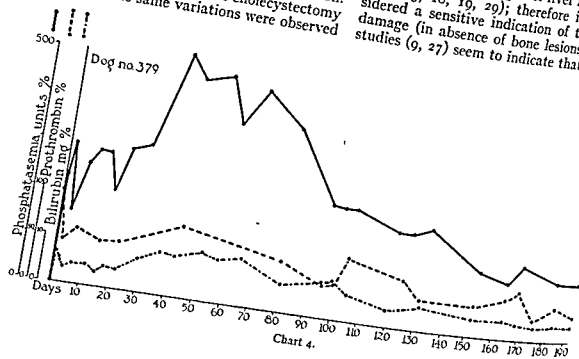
b. The bilirubinemia does not suffer any variation.

c. The prothrombinemia was not studied in these experiments since previous work done in this laboratory demonstrated that in cholecystomized dogs it changes only slightly during the first 24 hours following operation. This change is not due to the cholecystectomy itself since the same variations were observed

in dogs in which all the surgical steps, except the removal of the gall bladder, were repeated (3-6). The slight variations in the prothrombinemia do not last more than 24 hours and are attributed to the anesthesia and section of the tissues.

## COMMENT

The alkaline phosphatase is present normally in the blood serum and its increase has been related to different types of liver injury (1, 2, 8, 9, 15, 18, 19, 29); therefore it was considered a sensitive indication of the hepatic damage (in absence of bone lesions). Several studies (9, 27) seem to indicate that the liver



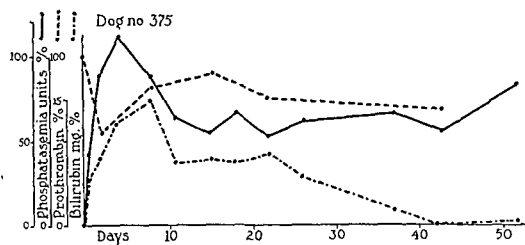


Chart 5.

is an important source of this enzyme. It is almost certain that the alkaline phosphatase excreted in the bile is of hepatic origin (15, 17).

Drill and associates (13) claim that the increase of the alkaline phosphatase activity of

serum accompanying the hepatic lesions is related to an alkaline phosphatase normally present in the blood in very small quantities and this might be the alkaline phosphatase II, which was extracted from the liver tissue by Cloetens.

Kabath obtained the release of the enzyme through cellular autolysis. Sharnoff, Lisa, and Riedel assert that the injured cells release phosphatase into the blood; consequently the degree of the injury regulates the enzyme level reached in the blood. Any agent able to produce necrosis or necrobiosis of the hepatic cells of the middle of the lobule (which contain phosphatase and apparently are the earlier

TABLE II.—RESULTS, CHOLECYSTECTOMY AND LIGATION OF COMMON DUCT

Dog	Days	Phosphatase		Bilirubin mgm. per 100 ml.	Prothrombin %
		Alkaline unit per 100 ml.	Acid unit per 100 ml.		
362	Initial	3.26	0.52	0.55	101
	1	105.6	1.89	6.58	63
	2	81.9	1.65	8.77	77
	4	90.9	0.41	11.52	83
	8	137.9	1.02	9.60	—
	12	161.9	1.21	6.25	93
	16	217.6	1.44	5.10	82
	21	272.8	1.83	4.33	85
	26	289.1	1.64	4.65	74.5
	30	272.9	1.01	3.20	80
	45	259.5	1.22	1.70	30.6
	50	305.7	1.43	1.50	32.8
	57	240.7	1.43	1.70	35.6
	64	295.7	2.24	1.20	30.9
	85	371.2	1.43	1.92	57.1
	94	404.3	1.42	1.75	—
	107	290.2	1.64	1.92	—
	122	143.5	1.90	1.35	48
	137	183	1.60	1.98	27
	150	127.7	0.91	1.70	35
	192	101.3	1.23	1.71	18
	204	78.2	1.02	1	20

TABLE III.—RESULTS

Dog	Days	Phosphatase		Bilirubin mg per 100 ml	Prothrombin %
		Alkaline unit per 100 ml.	Acid unit per 100 ml.		
375	Initial	1.43	0.61	0	101
	15 hours	68.3	1.84	5.12	—
	2 days	176.5	2.66	8.01	32.7
	4 days	222.8	0.83	12.2	—
	8 days	174.7	1.63	14.82	82.6
	11 days	125.9	0.81	7.63	—
	15 days	109.7	0.82	8.01	90.1
	18 days	132.5	1.84	7.63	—
	22 days	108.5	1.93	8.54	75.8
	25 days	116.4	1.42	6.08	—
	37 days	136.2	1.02	2.24	—
	43 days	113.8	1.03	0	69.4
	52 days	169.1	1.42	0.58	—

## SURGERY, GYNECOLOGY AND OBSTETRICS

TABLE IV.—RESULTS, CHOLECYSTECTOMY

Dog	Days	Phosphatase		Bilirubin mg per 100 ml
		Alkaline unit per 100 ml	Acid unit per 100 ml	
582	Initial	3.2	0.8	
	3	21.2	0.8	0
	10	45.4	0	0
	16	56.5	0	0
	24	33.8	0	0
	34	29.3	0.88	0
	50	6.3	0	0
585	Initial	2.7	0.9	0
	3	7.6	—	0
	10	19.8	0.8	0
	16	12.9	0.4	0
	24	9.9	0.45	0
	34	8.85	0.72	0
	50	2.52	0	0

sufferers of the injuries) will produce an abnormal release of the enzyme into the blood. Transfusion of dog's icteric blood (which contains increased alkaline phosphatase) to a normal dog, increases the blood phosphatase of the recipient, and this increase persists a considerable time after the bile pigments are excreted (15).

Our experiments show that the highest levels of blood alkaline phosphatase are obtained following experimental extrahepatic biliary obstruction. In hepatitis due to chloroform an increase is found which persists even after the prothrombinemia has reached its normal level. This increased phosphatasemia, which lasts only a few days, can be explained by the slow excretion of the excess phosphatase released during the period of the maximum injury produced by chloroform (48). The protein structure of phosphatase and the persistence of an alkaline phosphatasemia above the normal when the prothrombinemia has reached its normal level (chloroform hepatitis) might well be interpreted as an indication of a biliary obstruction or hepatic injury which is recovering. In other words, phosphatase is in the bile, once the enzyme reaches the blood either by cellular lysis or by

the bile pouring out into circulation the phosphatase can not be re-excreted through the biliary passages even if these have been completely restored. The experiment of the transfusion of icteric blood with increased phosphatase to a normal dog (15) referred to above warrants that conclusion. If this interpretation is correct, the determination of the alkaline phosphatasemia as a test of liver function would be submitted to a limitation which should be considered, especially if it is used as a single liver function test. In this latter case, the hyperphosphatasemia might denote a hepatic damage which had existed before. The doubt could only be cleared up by repeating the determination on succeeding days and by comparing the results with the results of other liver function tests. Even so, the comparative values will depend on the reliability of the tests chosen for the comparison.

In the work of Drill and Ivy (14) in studying the comparative sensitivity of tests, it was shown that the bromsulfalein test was the most sensitive in detecting hepatic damage. All the animals, except one, had hyperphosphatasemia at the same time or slightly after the bromsulfalein clearance had reached the normal values. Obviously the phosphatasemia was as sensitive as the bromsulfalein test. The prothrombin time was not so sensitive as the above mentioned tests, though it detected the hepatic damage prior to the galactose tolerance test.

In our experiments the prothrombinemia was the most sensitive test in detecting the hepatic injury produced by chloroform because it preceded the increase of the blood alkaline phosphatase. The results of Drill and Ivy are disputable concerning the prothrombin technique used by them. The difference in our results when compared with those of Drill and Ivy, cannot be accounted for by the different hepatotoxic drug used by us (chloroform) because it was demonstrated (3) that chloroform produces the same variations in prothrombinemia as does the carbon tetrachloride in similar experimental conditions. Our results show that prothrombinemia detects earlier than the phosphatasemia the hepatic damage produced by chloroform, and

its variations closely indicate the course of the injury as well as the reactive capacity of the liver. As has been said, phosphatasemia persisted at a high level even after prothrombinemia had reached its normal value and the high level was not the expression of a lesion in activity but in regression.

We have mentioned that the highest values of phosphatasemia are obtained in experimental extrahepatic biliary obstruction. It seems that phosphatasemia is a very sensitive index of biliary obstruction, either intrahepatic or extrahepatic, if the experimental results of ligation of the common duct and those of cholecystectomy are compared.

In extrahepatic biliary obstruction there are two factors to be considered: (a) the pouring off of bile (which contains the phosphatase secreted by the uninjured cells of the liver as well as other elements) into the blood stream; (b) the release of phosphatase directly into the blood by the injured cells. This explains the highest values of bilirubinemia and phosphatasemia found in this instance. The bile pigments are excreted through the kidneys, and this excretion accounts for the steady blood level that follows the initial increase (dogs 362 and 379) except when a rupture of the biliary tract (dog 375) suddenly dropped it to a 0 level. On the contrary the kidney is impermeable to phosphatase (17) and this persists at a high level in the blood nearly until the end of the experiment when the hepatic damage is severe and the hepatic insufficiency is at its height as is revealed by the marked hypoprothrombinemia. It is probable that at this moment the liver cells are deprived of phosphatase though its lysis does not increase the enzyme level in the blood (31).

In experimental biliary obstruction prothrombinemia is late in denoting the hepatic damage; only in the final period of the experiment is its value really low. These results confirm our earlier experiments (4) on experimental biliary obstruction in which it had been shown that prothrombinemia does not suffer significant variations (hemorrhagic levels) during the survival period of the animal, and that the hypoprothrombinemia and hemorrhagic tendency observed in the clinical cases of obstructive jaundice are due to the

injury of the hepatic cells, which complicates or follows the biliary obstruction, and is not due to the mechanical disturbance of the intrahepatic biliary stasis.

Special mention of the behavior of the acid phosphatase is necessary. In experimental biliary obstruction acid phosphatase does not vary in the same magnitude as does the alkaline; however, it increases and this increase is slightly higher than that observed in the chloroform experiments. In experimental biliary obstruction acid phosphatasemia parallels alkaline phosphatasemia variations although in a much smaller proportion. No explanation of this fact can be offered based on our present knowledge.

The results of the experiments of cholecystectomy revives the problem of cholecystectomy and dilatation of biliary ducts and hepatitis (7).

Cantarow (10) reported that cholecystectomy in man temporarily decreases the bromsulfalein excretion when the test is performed 24 hours following operation. Bergh (7) did not find functional hepatic changes in cholecystectomized dogs from 1 week to 15 months following operation; they used the bromsulfalein at a dose of 2 milligrams per kilogram of body weight, the van den Bergh reaction and the icterus index as liver function tests. As it was recently shown that the bromsulfalein test at a dose of 5 milligram per kilogram body weight is a more sensitive index, and that phosphatasemia is also a very sensitive index of the hepatic injury (14) Drill, Annegers and Ivy (12) restudied the effects of cholecystectomy on the hepatic function in dogs by means of both tests. Ten of 12 cholecystectomized dogs showed an increased phosphatasemia following the operation and in 9 of them this increase lasted as long as 70 days—the entire period of observation. Four of these 10 dogs showed an increased bromsulfalein retention. Drill, Annegers, and Ivy explain the hyperphosphatasemia observed following cholecystectomy in dogs on the basis of the experimental finding that cholecystectomy produces a dilatation of the bile ducts (7) and an incompetency of the sphincter of Oddi which permits transmission of the intraduodenal pressure into the biliary tract (20). They

were not surprised by the long lasting increased phosphatasemia after cholecystectomy though they considered it to be a sensitive index of the slight functional biliary obstruction connected with the dilatation of the intrahepatic bile ducts.

Our results confirm those of Drill (12) concerning the increase of the blood alkaline phosphatase following cholecystectomy in dogs. Although our studies were performed on only 2 dogs, the results closely coincide and warrant definite conclusions. However, in our animals the phosphatasemia returned to normal at an earlier period. This return to normal cannot be explained nor can the mechanism by which the functional changes of the intracanalicular pressure causes the phosphatasemia to rise.

The bilirubinemia does not change following cholecystectomy in dogs and this is not surprising if the great excretory capacity of the liver for bilirubin is recalled. Moreover, the increase of phosphatasemia is not necessarily associated with jaundice (15), and this is clearly shown in our cholecystectomy and chloroform experiments. These emphasize the concept of the existence of hepatic injuries which are not revealed by variations of the bilirubinemia.

Our comparative results show the existence of liver function tests which are very sensitive in their capacity to detect the hepatic damage, of the course of the lesion, the reactive capacity of the liver, and the minimal biliary obstruction.

We have not attempted to evaluate the different tests as aids in determining the differential diagnosis of jaundice because, as is known, the dog is not an experimental subject for that purpose since he requires very extensive and severe hepatic damage or a total biliary obstruction to produce a degree of jaundice of certain intensity. However, this does not nullify the value of the results obtained from the comparative study of the bilirubinemia with the other tests.

In spite of the limitations imposed by the fact that it is not always possible to apply the results of animal experimentation to the human, our experiments demonstrate that: (1) prothrombinemia is more sensitive than

phosphatasemia in detecting cellular hepatic lesions, the course of the lesion, and the reactive capacity of the liver against injury; (2) phosphatasemia is more sensitive than is prothrombinemia in detecting the minimal biliary obstruction, i.e. one which could be designated as *functional biliary obstruction*. These statements apparently suggest the idea of the existence of a dissociation of the liver function tests which obviously implies the concept of a dissociation of the functions of the liver (metabolic and excretory). This is not erroneous so far as it is concerned with the reserve power of the liver. However, in accepting this idea one is forced to consider the existence of a systematized pathologic histology of the liver (pure forms of cellular injury and pure forms of canalicular injury) which, as is known, does not agree with the clinical reality.

The evidence points out that a given degree of hepatic injury does not equally affect the different functional activities of the liver in a quantitative manner, and, in order to gain knowledge of the course of any kind of hepatic damage, it is necessary to perform a series of different liver function tests. Therefore, the above concept should be replaced by the concept of quantity of injured parenchyma or by that of lesser or greater sensitivity of the liver function tests.

Despite the concept brought out by the experimental hepatic pathology that a minimal quantity of healthy liver parenchyma can accomplish some functional activities as normally, the analysis of our results, *considering the liver as a whole*, demonstrates that prothrombinemia detects earliest the damage of the hepatic cells, but that phosphatasemia is more sensitive in revealing biliary obstruction. As the severity of the damage increases both tests become abnormal and probably other less sensitive tests do also. This concept is in accordance with the idea of Ivy (14) of a *quantitative association* of the liver function tests instead of a *qualitative dissociation* of the liver's functions.

#### CONCLUSIONS

1. Chloroform anesthesia of 1 hour's duration produces in the dog a hypoprothrombin-

mia and an increase of the alkaline phosphatase in the blood. The decrease in the prothrombin concentration precedes the hyperphosphatasemia and it reaches its maximum during the 24 to 48 hours following the anesthesia, while the highest value of the phosphatasemia is recorded between 48 and 120 hours following the anesthesia. By the 5th or the 6th day the prothrombinemia has reverted to its normal value while the phosphatasemia remains above the normal level until the 10th to 13th day.

The value of the bilirubinemia is not greatly modified, ascending slightly and reaching its maximum between 24 to 48 hours and then reverting to normal.

All these changes are closely related to the degree of the hepatic injury produced by the chloroform.

2. Cholecystectomy and ligation of the common duct produce in the dog an increase of the serum alkaline phosphatase greater than in the experiments of chloroform intoxication (150 times the normal initial level). Fifteen hours following the operation the increase is very pronounced but the maximum value is reached at the end of a variable period which oscillates between the 4th and the 94th day. Then an irregular but constant decline begins and this decline lasts until the death of the animal.

The acid phosphatase activity parallels the alkaline but not in the same proportion. This increase is slightly greater than in the chloroform intoxication.

The prothrombinemia is late in revealing the hepatic damage due to the obstruction; only in the final period of the experiment is its value consistently low.

The bilirubinemia increases after the ligation of the common duct. The maximal concentration is obtained between the 4th and the 52nd day following the operation. Afterward it stabilizes at a level slightly above the normal.

3. Cholecystectomy alone produces an increase of the alkaline phosphatase; the increments are greater than in the chloroform exiliary obstruction. The maximum level is observed between the 10th and the 16th day

following the operation. Afterward a decline begins which reaches the normal level at the end of the 50th day.

The bilirubinemia does not suffer any variation.

The prothrombinemia suffers very slight variations during the first 24 hours after the operation and it is not related to the cholecystectomy itself.

4. A comparative study of the results demonstrates that prothrombinemia is more sensitive than phosphatasemia in denoting cellular hepatic lesion. The phosphatasemia is more sensitive than is prothrombinemia in detecting minimal biliary obstruction; i.e. one which could be designated as a functional biliary obstruction. As the severity of the damage increases, both tests become abnormal. It is concluded that it is more reasonable to accept the concept of a quantitative association of the liver function tests rather than of qualitative dissociation of the liver's functions.

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The acid phosphatase activity parallels the alkaline but not in the same proportion. This increase is slightly greater than in the chloroform intoxication.

The prothrombinemia is late in revealing the hepatic damage due to the obstruction; only in the final period of the experiment is its value consistently low.

The bilirubinemia increases after the ligation of the common duct. The maximal concentration is obtained between the 4th and the 52nd day following the operation. Afterward it stabilizes at a level slightly above the normal.

3. Cholecystectomy alone produces an increase of the alkaline phosphatase; the increase is greater than in the chloroform experiments but less than in the experimental biliary obstruction. The maximum level is observed between the 10th and the 16th day

following the operation. Afterward a decline begins which reaches the normal level at the end of the 50th day.

The bilirubinemia does not suffer any variation.

The prothrombinemia suffers very slight variations during the first 24 hours after the operation and it is not related to the cholecystectomy itself.

4. A comparative study of the results demonstrates that prothrombinemia is more sensitive than phosphatasemia in denoting the cellular hepatic lesion. The phosphatasemia is more sensitive than is prothrombinemia in detecting minimal biliary obstruction; i.e. one which could be designated as a functional biliary obstruction. As the severity of the damage increases, both tests become abnormal. It is concluded that it is more reasonable to accept the concept of a quantitative association of the liver function tests rather than of qualitative dissociation of the liver's functions.

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# SURGICAL TREATMENT OF PANCREATIC CYSTS

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**P**ANCREATIC cyst is a disease of infrequent occurrence, although it is encountered often enough to merit some consideration in regard to accurate diagnosis and effective treatment. A review of the accumulated clinical records reveals that this diagnosis has been made in only 9 cases since the origin of the Lahey Clinic in 1926 to October 1, 1945.

Pancreatic cysts are usually observed in patients in middle life. They have been found to be present, however, at an early age, 1 case being reported in a 5 month old child (5). According to several reports in the literature, the two sexes are affected with equal frequency. (6, 18). In the present series of 9 cases there were 6 females and 3 males. The youngest was 18 and the eldest 71 years of age.

Robson and Cammidge classified pancreatic cysts into the following groups:

1. *Retention cysts*, which are lined with epithelium and are caused by obstruction in the pancreatic duct, smaller ducts, or acini.

2. *Proliferation cysts*, the result of proliferation of glandular epithelium followed by an accumulation of fluid. These are tumor formations (cystadenomas).

3. *Congenital cysts*.

4. *Hemorrhagic cysts*, secondary to necrosis and bleeding.

5. *Hydatid cysts*.

6. *Pseudocysts*, produced by trauma or degenerative changes of the interstitial tissue of the pancreas. These are distinguished from true cysts in that they are not within the substance of the pancreas but outside it and usually lie in the lesser omental sac. They have no epithelial lining.

7. *Dermoid cysts* (added by Judd, 12).

A summary of the types of pancreatic cysts which are found in this series is presented in Table I.

In the earlier literature, trauma was frequently mentioned as the etiologic agent in

the production of pancreatic cysts (10, 16, 17, 23). No accurate estimation of the percentage of frequency with which trauma was a causative factor can be made. In this group of cases, history of trauma was elicited in only 1 case.

More recently, the rôle of acute and chronic pancreatitis as the etiologic agent has been emphasized (12, 18). The pathogenesis is still undecided. It has been suggested that partial obstruction of the pancreatic ducts may lead to necrosis of the tissues by the pancreatic enzymes (4, 24). Archibald believed that pancreatitis may be the result of bile entering the pancreatic duct. In 3 cases of the present group, there was associated disease of the biliary tract. There was a previous history of jaundice in 3 of the cases. One patient had undergone elsewhere an exploratory laparotomy for acute cholecystitis; in another case, cholecystostomy had been done previously. Gallstones were noted in 2 of these cases at operation (Table II).

## ANATOMY

An anatomical study shows the pancreas lying in the epigastrium and left hypochondrium in a retroperitoneal position, behind the serosal floor of the lesser omental sac, at the level of the first and second lumbar vertebrae. It is bounded posteriorly by the nonresilient posterior abdominal wall, and for this reason lesions of the pancreas are likely to extend forward in the direction of least resistance, and usually into the lesser sac. A diagrammatic sagittal section through the body of the pancreas demonstrates more clearly the various locations in which a pancreatic cyst may be found (Fig. 1).

The three most common locations occupied by pancreatic cysts are listed in order of frequency, according to Judd, Mattson, and Mahorner (13).

1. Cyst presenting between the stomach and transverse colon, and behind the gastocolic ligament.

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TABLE I.—TYPES OF PANCREATIC CYSTS

Case	Sex	Age, years	Type of cyst
1	F	43	Papillary cystadenocarcinoma
2	F	71	Pseudocyst
3	F	58	Hemorrhagic cyst
4	F	39	Pseudocyst
5	M	45	Pseudocyst
6	F	51	Papillary cystadenocarcinoma
7	F	47	Pseudocyst
8	M	18	Pseudocyst
9	M	32	Pseudocyst

2. Cyst protruding into the lesser sac and presenting between the stomach and liver.

3. Cyst lying between the layers of the mesocolon, either behind the transverse colon or below it.

Rarely, these cysts may assume a position behind the descending colon, and may even descend into the pelvis.

In this series, the pancreatic cyst presented between the stomach and liver in 2 cases; posterior to the stomach and pressing against the gastrohepatic omentum in 2 cases; along the lesser curvature of the duodenum in the head of the pancreas in 3 cases; along the lesser curvature of the stomach in 1 case, and at the root of the mesocolon in 1 case.

#### DIAGNOSIS

Pain is the most frequent symptom. It is usually experienced in the right hypochondrium and epigastrium, and may be referred

to the back. Its intensity varies from a dull ache to a fairly severe pain requiring sedation. Frequently there may be only symptoms of pressure on the neighboring organs, especially on the stomach, with anorexia and epigastric discomfort after meals, which may be accompanied by nausea and vomiting and gaseous distention.

The presence of an abdominal mass situated above the level of the umbilicus, usually in the left hypochondrium, is the most helpful and reliable diagnostic sign. The surface of the cyst is likely to be smooth, tense, and immobile, except for those cysts located in the tail of the pancreas. Unless such a mass is palpable or demonstrable by roentgenographic study, a diagnosis of pancreatic cyst is difficult or impossible.

Roentgenologic examination is a major aid in the diagnosis of cysts of the pancreas. The presence of an enlarged duodenal loop, or a filling defect of the stomach, duodenum, or transverse colon produced by an extrinsic mass is evidence in support of a presumptive diagnosis of a pancreatic cyst.

Since a pancreatic cyst may extend into any part of the abdominal cavity, it must be distinguished from a distended gall bladder, omental or mesenteric cyst, hydronephrosis, a retroperitoneal tumor, an ovarian cyst, and cysts or tumors of the liver.

#### SURGICAL TREATMENT

There are three established procedures to be considered in the surgical treatment of pan-

TABLE II.—FINDINGS IN THE BILIARY TRACT IN 9 CASES OF PANCREATIC CYST

Case	Biliary tract history				Operative findings of biliary tract
	Cholecystitis	Gallstones	Jaundice	Previous operations	
1	o	o	o	o	Normal
2	+	+	+	o	Gall bladder scarred and small; a gall stone
3	o	o	o	o	Pancreatitis?
4	+	+	+	Cholecystostomy	Several small gall stones. Common bile duct dilated. No stones in common bile duct.
5	+	o	+	Exploratory laparotomy	Normal
6	o	o	o	o	Normal
7	o	o	o	o	Normal
8	o	o	o	Exploratory laparotomy	Normal
9	o	o	o	Exploratory laparotomy	Normal

and drainage had ceased. There was no sign of diabetes mellitus. On October 17, 1943, she died from a cerebrovascular accident.

CASE 3. A white female, aged 58, was seen in the clinic on May 18, 1943. For the past 5 years she had suffered from intermittent attacks of nausea. A roentgenogram taken by her physician was said to show a cyst of the liver. One week previously sharp pain occurred under the left scapula; the pain extended to the right side.

On physical examination, an irregular mass, which moved with respiration, was outlined just below the left costal margin.

All laboratory studies were negative.

An exploratory laparotomy was performed on June 14, 1943, by Dr. S. F. Marshall. A cyst about 10 centimeters in diameter was found extending from the body of the pancreas. It was located posterior to the stomach and extended upward against the gastrophrenic omentum. A smaller cyst, 2 centimeters in diameter, was located posteriorly and attached to the posterior abdominal wall. These two cysts were excised. Two cigaret drains were placed in the area through a stab wound in the left flank.

The pathologic report was hemorrhagic cyst with fibrous wall, probably the result of localized pancreatitis.

Follow-up examination on August 6, 1943, demonstrated mild diabetes. On November 29, 1943, a glucose tolerance test showed mild diabetes mellitus. Drainage had ceased on August 6, 1943.

CASE 4. A white female, aged 39, was seen at the clinic on November 15, 1943. About 2 years previously, cholecystostomy was performed elsewhere for attacks of right upper quadrant pain and vomiting. Many stones were removed from the gall bladder at that time. Mild jaundice was present before that operation. Since then she had had one attack of pain over the right upper quadrant, which lasted for 2 weeks. There was no jaundice.

Physical examination gave negative results. All laboratory studies were negative. A cholecystogram showed an outline of the gall bladder containing several very small negative shadows. Roentgenograms taken after a barium meal and barium enema were normal.

On January 14, 1944, operation was performed, by Dr. C. C. Engleman. A cyst, measuring about 2 centimeters in diameter, was found at the root of the mesocolon. Several small gallstones were found in the gall bladder. The common bile duct was dilated and contained no stones. The cyst was located at the inferior border of the head of the pancreas. The pancreas was hard, and the capsule thickened, suggesting a previous attack of pancreatitis. The cyst was excised. Cholecystectomy and choledochostomy were carried out. A cigaret drain was placed in the pancreatic area, and a Penrose drain placed in Morrison's pouch.

The pathologic report was cyst, with fibrous wall. Follow-up examination on February 16, 1944, showed no drainage from the site of the pancreatic

cyst. The patient has had no recurrence of symptoms or cysts.

CASE 5. A white male, aged 45, was seen at the clinic on February 2, 1944. In 1939, laparotomy had been performed elsewhere for cholecystitis. The gall bladder was not removed. However, an appendectomy was done. Following this he had had abdominal pain intermittently. Three weeks previously he had had an attack of jaundice which lasted for 3 days. He had lost 30 pounds in weight in 2 months.

Physical examination gave negative results. All laboratory studies were negative except for a glucose tolerance test which was suggestive of diabetes mellitus. A cholecystogram was negative. A roentgenogram taken after a barium meal showed an enlargement of the duodenal loop with compression of the first portion of the duodenum.

Operation was performed on March 1, 1944, by Dr. Ralph Adams. A cyst about 6 centimeters in diameter was found arising from the head of the pancreas and occupying a position in the curve of the duodenum. This cyst was anastomosed to the jejunum as described previously.

The pathologic report was fibrosis and chronic inflammation.

The patient was discharged on March 18, 1944, after an uneventful convalescence. He was seen on April 28, 1944, and at that time he had no symptoms of any distress. On May 5, 1944, a gastrointestinal roentgenologic study was done. This showed a decrease in the size of the cyst, with no evidence of any barium in the cyst cavity. On August 15, 1945, another fluoroscopic and gastrointestinal roentgenogram again showed a decrease in the size of the cyst; no barium entered the cyst.

CASE 6. A white female, aged 51, was seen at the clinic on May 22, 1945, complaining of epigastric discomfort for the past 3 years. The gnawing ache in her epigastrium was aggravated by eating. About 6 months previously she noticed a mass in the left upper quadrant which steadily increased in size.

Physical examination showed a mobile smooth mass in the left upper quadrant. All laboratory studies were negative. Fluoroscopy and gastrointestinal roentgenograms showed a deformity of the stomach produced by a large mass in the left upper quadrant. An intravenous pyelogram was normal.

Operation was performed on June 23, 1945, by Dr. Ralph Adams. A large cyst, 12 centimeters in diameter, was found arising from the body of the pancreas. The stomach was displaced downward. The cyst contained many papillomatous masses, and frozen section showed it to be carcinomatous. Cystojejunostomy was performed as described previously.

The pathologic report was papillary cystadenocarcinoma.

The patient made an uneventful convalescence and was discharged on July 15, 1945. She was seen in the clinic on August 15, 1945, and had no complaints. The mass was still palpable. Fluoroscopy and gastrointestinal roentgenograms showed the cyst with no barium entering it.

Some surgeons have objected to an anastomosis between the pancreatic cyst and the gastrointestinal tract in the belief that the intestinal contents may enter and lead either to suppuration or to an activation of the enzymes in the true pancreatic cysts. They depended on the resorptive power of the gall bladder to remove the fluid produced by the cyst. Walzel performed a primary anastomosis between the cyst and the gall bladder and, to prevent a reflux of bile, the cystic duct was ligated. The rationale for the cystic duct ligation is difficult to understand. Neuffer performed a similar operation but did not ligate the cystic duct. Meyer obtained satisfactory results using the technique of Neuffer.

#### SURGICAL PROCEDURE

In 2 cases encountered in the clinic in the past 2 years, the patients were treated by doing a cystojejunostomy. The results to date have been very satisfactory and the surgical procedure is described below.

Exposure of the pancreatic cyst is made either through the gastrocolic or the gastrohepatic omentum. A rent is made in the mesocolon, through which a loop of jejunum about 35 centimeters from the ligament of Treitz is drawn. The jejunal serosa is sutured to the cyst wall with a row of interrupted silk sutures. The cyst is then aspirated and an incision 2.5 centimeters in length is made in its wall. A similar parallel incision is made in the jejunum. A posterior layer of sutures unites the cyst lining with the intestinal mucosa. A row of interrupted Connell sutures is placed, thus inverting the anterior walls of the cyst and jejunum. This is reinforced with another layer of interrupted silk sutures. Two sutures are placed at each angle to buttress the jejunum to the pancreas. A jejunojejunostomy of the efferent and afferent loops is then made about 15 centimeters from the ligament of Treitz.

#### CASE REPORTS

**CASE 1.** A white female, aged 43, was seen at the clinic on July 19, 1927, because of soreness and pain over the right upper abdomen, which had been present since April 9, 1927. This had persisted for several days and was not related to food intake. On May 9, 1927, she began to have sharp pain over the same

area, accompanied by nausea and vomiting, and morphia was required for relief. On June 3, 1927, a mass appeared in the left upper quadrant.

Laboratory studies were negative. Fluoroscopic examination showed an extrinsic pressure defect on the stomach, between the antrum and media, causing an hour-glass deformity. The interpretation was pancreatic tumor.

On July 22, 1927, operation was performed by Dr. F. H. Lahey. The approach was made through the gastrohepatic omentum. A cyst about 7 centimeters in diameter was found projecting from the body of the pancreas. The cyst was opened, and the friable contents removed. The lining was painted with iodine, and a cigaret drain inserted. The edges of the cavity were sutured to the peritoneal edges around the drain.

The pathologic report was papillary cystadenocarcinoma of the pancreas.

There was no postoperative complication. The patient was discharged on the tenth day with a discharging sinus.

Follow-up examination of this patient showed a small discharging sinus on August 7, 1927. On September 11, 1927, there was no sign of diabetes mellitus. The patient died December 11, 1927, from metastasis of this carcinoma.

**CASE 2.** A white female, aged 71, came to the clinic on September 25, 1941, because of an abdominal mass of 3 years' duration. She complained of occasional dull pain in the right upper quadrant of the abdomen which occurred after eating. She had had a short period of jaundice about 4 years previously. In 1932 she was operated upon for pancreatitis. The findings at this operation are not available.

Physical examination showed a tumor mass filling the upper abdomen, extending about 5 centimeters below the umbilicus.

Laboratory studies were negative. A partial gastrointestinal roentgenologic examination showed the stomach to be displaced by an extragastric mass lying along the lesser curvature. An intravenous pyelogram showed displacement of the left ureter by this mass, with probable pressure on the left renal pelvis.

Operation was performed September 29, 1941 by Dr. S. F. Marshall. A cyst about 25 centimeters in diameter was found lying posterior to the lower portion of the stomach and one of the loops of the small bowel. Four liters of fluid was removed from the cyst. A stab wound was made in the left flank. The wall of the cyst was brought out through this incision and sutured to the peritoneum and muscle. It was likewise sutured to the skin with interrupted black silk sutures. Two cigaret drains were placed into the interior of the cyst. The gall bladder was small and scarred, and contained two stones.

The patient was discharged on October 19, 1941, and was seen in the clinic thereafter. The drainage continued until May 21, 1942. The patient was seen on July 16, 1943; there was no recurrence of the cyst

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## SEVERE BURNS: CLINICAL FINDINGS WITH A SIMPLIFIED PLAN OF EARLY TREATMENT

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**D**ESPITE the tremendous amount of clinical and experimental study, much of it stimulated by the war, there is considerable confusion in the minds of many surgeons as to the preferred method of immediate and early treatment when confronted by a serious thermal injury. The purpose of the present communication is to describe the clinical findings following a plan of treatment reduced to its simplest details. It must be emphasized, however, that no plan can take the place of careful clinical study of the individual case. Nevertheless, the results obtained seem sufficiently good to suggest that therapy based on such a plan may be preferable to more intricate and complicated methods. The large literature on the treatment of burns will not be reviewed; it has been well done by Harkins and others.

### SELECTION OF MATERIAL

During the 2 year period of study 112 burn cases were considered severe enough to justify admission of the patient to the hospital. Only about half, or 55 cases, were selected for analysis. First, no case was included in which the patient did not arrive in the hospital within a few hours of injury and in which he did not remain in the hospital until full treatment was carried out. Second, in order to study only severe cases, all patients with

burns involving less than 10 per cent of the body surface were excluded, with the exception of 4 patients in this group requiring skin graft.

### PLAN OF THERAPY

On entrance into the receiving room all exposed burned areas were covered with a sterile sheet and blanket. Morphine or codeine injections were not given as routine but only to control pain or apprehension, respectively, when present. As routine a prophylactic dose of antitetanus serum was injected. Full treatment was carried out in the following chronological order after arrival at a dressing room off the surgical wards.

*Intravenous injections.* It was accepted as axiomatic that the voluntary oral route for the administration of needed food and fluid elements was preferable to the parenteral channel, which should be employed only when necessary. In other words, only when the oral route was ineffective, particularly in meeting acute deficits, were intravenous injections used. Plasma transfusions were therefore not given as routine, were not based on the extent of the burn, but were used primarily for the treatment of shock when present, or prophylactically when shock seemed imminent. This routine required constant observation of the patient, particularly during the first 24 to 48 hours, inasmuch as some patients entered the hospital in good general condition, but developed signs of shock after several hours, or responded to one transfusion only to fall into shock again later. Although pronounced hemoconcentration is

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**CASE 7.** A white female, aged 41, was seen at the clinic on June 29, 1945, complaining of weakness, dizziness, and attacks of unconsciousness. Studies showed her to have an islet cell tumor of the pancreas. On July 5, 1945, an operation was performed, and an islet cell tumor in the head of the pancreas was removed. The pathologic report was islet cell adenocarcinoma.

On September 10, 1945, pain appeared in the left hypochondrium. This pain was fairly severe and extended to the back. Roentgenographic examination of the stomach showed a crater deformity on the posterior wall of the fundus of the stomach.

On October 4, 1945, an exploratory laparotomy was performed by Dr. S. F. Marshall. A collection of slightly cloudy fluid in a thin walled cyst was found in the left subphrenic area, and also between the stomach and pancreas. The pseudocyst was evacuated. The wound healed on removal of the drain, and she was discharged on the nineteenth postoperative day, symptom-free. No evidence of metastasis or recurrence of adenocarcinoma of the pancreas was found.

**CASE 8.** A white male, aged 18, was seen at the clinic on January 22, 1936, complaining of a draining abdominal sinus for the past 3 months. About 3 months previously following an upper abdominal injury, an exploratory laparotomy was performed elsewhere, and a large hematoma was found lying between the two layers of the gastrosplenic omentum. The abdomen was closed without drainage. The postoperative course was complicated by the appearance of a discharging sinus.

Physical examination showed a discharging fistula in a healed upper right rectus incision, surrounded by an area of irritated skin.

On January 22, 1936, a gastrointestinal roentgenogram, taken after lipiodol injection of the sinus, showed the fistula to be in the region of the head of the pancreas.

Conservative management was then instituted with diet, alkaline powders, and belladonna. When no improvement was shown under this regimen, the pancreatic fistula was transplanted into the jejunum on March 16, 1936 (operation performed by Dr. F. H. Lahey). The postoperative course was uneventful, and the patient was discharged from the hospital on April 3, 1936.

In August 1936, another abdominal injury necessitated another exploratory laparotomy elsewhere. The fistulous tract into the jejunum was not injured.

The patient was symptom-free until July 22, 1941, when severe pain developed in the upper left portion of the abdomen, accompanied by nausea, vomiting, and a temperature of 102 degrees F. He was then admitted for study. A diagnosis of subacute pancreatitis was made. Following a period of medical management, he was discharged on October 10, 1941, improved.

**CASE 9.** A white male, aged 32, was seen at the clinic on June 18, 1944, complaining of a draining pancreatic fistula of 15 months' duration. In May

1942, an exploratory laparotomy was performed elsewhere for acute pancreatitis. No drainage was carried out. In March 1943, this patient was operated on elsewhere, presumably to have a cholecystectomy performed for a nonfunctioning gall bladder. A pancreatic cyst was found, however, and since it was too small to be marsupialized, it was opened and drained with a cigaret drain. This drain was removed 3 months later. Since then the sinus has continued to drain, occasionally requiring probing to relieve the obstruction which caused a great deal of pain.

Physical examination showed a healed upper right rectus incision with a small fistulous opening at the upper end of the scar. The surrounding skin showed a chronic irritation. All laboratory studies were negative.

On June 20, 1944, the fistula was transplanted into the jejunum, Dr. F. H. Lahey performing the operation. The postoperative course was normal, and the patient was discharged on July 19, 1944.

Follow-up by correspondence showed this patient to be symptom-free until December 19, 1945, when he revealed that he has been having left hypochondriac pain extending to the back for the past month. He is to be readmitted for further study.

#### SUMMARY

The literature on pancreatic cyst is reviewed. Nine additional cases are reported. The anatomic, physiologic, and pathologic features peculiar to this lesion are enumerated. The symptoms, signs, and examinations upon which a diagnosis may be made are discussed. Internal drainage by means of cystojejunostomy is recommended when extirpation of the cyst is not feasible, and the technique employed in establishing this anastomosis is described.

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**Chemotherapy.** No local chemotherapy was used whatever. As a routine, sulfathiazole, 1/10 gram per kilogram per day was given by mouth. However, if there was any contraindication to the use of sulfathiazole, it was not given. In a few patients penicillin was used early in doses of 160,000 units per day, but more commonly and effectively later in preparation for skin grafting. All primary chemotherapy was discontinued by the end of the first week unless there was evidence of infection.

**Preparation for skin graft.** Preparation for skin graft presented the greatest problem in the treatment of full thickness burns and will not be described in this paper. All sorts of methods were used, including proteolytic ferments. In general, wet saline packs were found to be the most effective, although they left much to be desired.

**Nutrition.** Though listed last, attention to nutrition, including oral fluid intake, was given a high priority in the present plan of treatment. Practically all patients suffered great thirst on admission and it was not necessary to urge them to ingest a large quantity of liquids. From the very beginning these liquids were of high nutritional value and included high protein and caloric drinks, ice cream, etc. A high intake of sodium chloride based on the experimental findings of Rosenthal and the clinical studies of Fox was not a part of the present plan. It is likely, however, that all patients did ingest large amounts of electrolyte in their food and drink. Vomiting was infrequent, but when it occurred was usually transient or beneficially influenced by plasma transfusions, in patients suffering from circulatory impairment and in whom vomiting was a manifestation thereof.

The assurance of a good nutritional intake was not left to chance, to a dietary order, or to the efforts of the dietician. A specific amount of fluids and food was ordered just as in the case of medication. Moreover, the intake was checked each day to be sure that most of it was taken. In addition, the urinary output was measured and if it fell below 1000 cubic centimeters the intake was checked, and if inadequate, efforts were made to see that it was maintained at several liters or more a day.

If the patient refused to eat a normal, well balanced diet, a high protein milk diet was ordered which in one liter contains 100 grams of protein and 1000 calories, which was considered as the daily minimum for an average sized adult. When possible the patient was urged to take 200 grams of protein and 2000 or more calories, particularly after the first few days. The threat of tube feeding was used in many patients, but was not employed in any of the present cases. Large amounts of ascorbic acid were given, 1 gram or more a day. An important feature of a good nutritional intake is that it start at once, i.e., as soon as the patient is dressed. Prevention is far easier than cure. If severely burned patients are allowed to lose much body tissue, the problem of restoration is extremely difficult even with a large dietary intake. The importance of maintaining good nutrition in burned patients has been well and extensively studied by Levenson, Davidson, Lund, and Taylor.

Early movement of the patient was encouraged and, unless the lower extremities were involved, the patient was urged to get up out of bed as soon after the dressings were applied as possible. If the lower extremities were involved, an attempt was made to get the patient into a wheel chair. When the upper extremities were involved it was obviously necessary to provide frequent nursing care in order to insure an adequate nutritional intake.

#### CLINICAL FINDINGS

Because of the tremendous variation in the findings it is difficult to summarize them adequately. To aid in the analysis, all patients were divided into three groups and the main details summarized in three tables as follows: Table I, those which healed without the use of skin graft; Table II, those which healed with skin graft; Table III, fatal cases.

Text figures of changes in the red count will be presented to illustrate findings of special significance. Reference will be made to them in the following general discussion of the results of the study.

**Systemic manifestations on entrance.** The most common symptom was thirst, which was almost universally observed in practically all



often used as an indication for the injection of plasma, and did nearly always accompany the appearance of shock, it was used as a routine indication in the present series only when the red count increased progressively. Many patients with hemoconcentration were not in shock and recovered without any intravenous therapy. This fact was also true in several cases with a large involvement of the body surface. If there were no systemic manifestations other than moderate hemoconcentration, plasma was, with few exceptions, withheld. Whole blood was given only when evidence of anemia developed or in conjunction with skin grafting. Saline and glucose solutions were injected only in connection with plasma transfusions and in the only case with persistent vomiting. A high fluid intake by mouth was maintained from the beginning, as described in detail under nutrition.

The amount of plasma given depended on the severity of the shock. No rigid formula was used, but for an adult at least 500 cubic centimeters was started as the initial dose. In the most severe cases larger amounts, e.g., 20 cubic centimeters per kilogram of body weight, or about 1500 cubic centimeters for an average sized adult, were injected. The rate of administration was quite rapid to combat shock, and more plasma was injected if the clinical response was not sufficient, or was repeated if circulatory impairment recurred.

*Débridement and cleansing.* No débridement whatever was carried out in any patient even in several in whom home remedies had been applied, such as talcum powder, sulphur ointment, lard, baking soda, bluing, and molasses. However, none of the burns was grossly dirty. Blisters were left intact and no attempt whatever was made to remove shreds of skin or other loose tissue. Cleansing was gently carried out with soap and water, but largely over the intact skin next to the burned area. Omission of débridement in fresh, clean burns was first formally recommended by Cope as a result of treating the victims of the Coconut Grove disaster; its use in the present plan was based largely on his excellent results.

*Dressing.* The basic principles involved in the application of a dressing to the burned area in order to avoid infection was thoroughly

described by Colebrook and his coworkers. Their excellent results prompted the use of these principles. The first and most important principle was the maintenance of scrupulous aseptic technique, the same, indeed, as that employed in the operating room. A rigidly observed detail was the masking of the patient and of all personnel during dressing. Next to the burn a layer of fine mesh gauze or other fabric was applied with or without some type of ointment. Over the primary layer of fabric a bulky layer of gauze was applied and held in place with a firm circular bandage. Pressure by means of cotton waste or elastic bandage was used in a number of cases, but was not adopted as a routine. A plaster splint for the extremities was sometimes included in the dressing. A bulky dressing, however, was always used because it absorbed discharges and seemed partly to immobilize the part.

Another important detail was the application of dressing well beyond the obviously burned area of skin, for reasons mentioned below. A third feature of the dressing was the fact that it was allowed to remain in place as long as possible, usually 10 to 14 days. It was removed earlier only when necessary because of pain, high fever, or excessive discharge. It was found advisable to explain this policy of infrequent dressing to the patient and the family in order to prevent a tendency for them to complain of neglect, which frequently occurred unless the plan was explained beforehand.

*Burns about the buttock.* In burns in the general region of the anus, particularly in children, a constipating regimen with paregoric was instituted and maintained for about a week. After this period enemas were ordered and given each day at a specific time when a member of the house staff was present, so that the dressing could be changed at once if necessary in order to prevent undue contamination. This seemed to work very well and probably played an important part in the prevention of secondary infection.

*Oxygen inhalations.* Patients who showed evidence of pulmonary injury or those suffering from respiratory distress for other reasons were placed in an oxygen tent during the first few days.

TABLE II.—BURNS WHICH HEALED WITH SKIN GRAFT

Case	Age, sex	Extent (% body surface)	Fever (°F.) Duration (days)	Day 1st change of dressing	T (°F.) Day 1st change of dressing	Day of discharge	Thermal agent	Hemoconcentration highest RBC (mill/c mm)	Remarks
27	15-M	15	101-5	12	Normal	240	Flash	None	
28	3-M	10	101-1	12	Normal	150	Flame	5.8	500 c.c. plasma
29	38-F	30	101-5	11	101	150	Flame	4.2*	500 c.c. plasma
30	21-F	40	104-2	12	100	90	Flame	8.9	1000 c.c. plasma (see text Fig 4)
31	16-M	20	101-2	12	100	90	Flash	5.2	500 c.c. plasma
32	6-M	6	None	10	Normal	34	Flame	None	
33	24-F	30	101-2	10	100	138	Flash	5.8	1500 c.c. plasma (see text Fig 5)
34	25-F	10	None	10	Normal	44	Flame	None	
35	9-M	12	101-3	9	100	124	Flash	None	
36	15-M	5	103-5	6	100	50	Hot water	None	
37	45-M	6	101-1	4	100	120	Flame	None	
38	4-M	6	None	10	Normal	102	Flame	None	
39	3-M	38	None	10	Normal	104	Hot water	None	
40	7-M	30	104-1	13	101	—	Flash	8.6†	1000 c.c. plasma (see text Fig 6)
41	36-F	40	104-1	7	102	120	Flame	5.6†	250 c.c. plasma
42	28-F	30	103-1	8	101	340	Flame	None	7 mo pregnant. Aborted 24 hrs
43	2-F	22	101-2	5	101	—	Flame	None	

\*Patient malnourished and probably anemic at time of burn.

†Only patients of this group in shock or with toxemia soon after admission to hospital

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1	25-F	30	None	12	Normal	37	Flame	61	500 c c plasma
2	4-F	15	None	13	Normal	35	Hot water	51	
3	8-F	15	101-1	13	100	31	Hot water	53	
4	1-M	20	100-2	14	Normal	26	Hot water	525	
5	1-M	40	102-1	13	Normal	36	Hot water	562	
6	3-M	30	102-1	6	101	39	Hot water	81	See Fig 1
7	6-F	10	None	13	Normal	15	Hot water	None	
8	2-M	20	104-1	6	101	18	Hot water	52	
9	9-M	10	None	14	Normal	24	Flame	None	
10	40-F	40	None	12	Normal	28	Flame	68	See text Fig 2
11	31-F	25	101-1	13	Normal	84	Flame	58	500 c c plasma
12	14-F	10	None	6	Normal	8	Hot water	None	
13	21-F	20	None	12	Normal	12	Hot water	65	
14	25-F	13	None	7	Normal	12	Flash	None	
15	3-M	12	102-2	12	Normal	28	Hot water	None	
16	39-F	15	None	9	Normal	13	Hot water	None	
17	1-F	30	102-f	8	101	17	Hot water	None	
18	51-M	45	100-4	5	Normal	50	Hot water	55	See text Fig 3 1600 c c plasma
19	5-F	10	None	5	Normal	18	Hot water	None	
20	7-M	30	None	10	Normal	63	Hot water	None	
21	5 F	40	100-2	13	Normal	21	Hot water	None	
22	1-M	15	None	5	Normal		Hot water	None	
23	10-M	20	None	9	Normal	13	Flame	None	
24	13½-M	15	None	10	Normal	15	Hot water	None	
25	13½-M	10	None	19	Normal	20	Hot water	None	
26	70-F	30	103-5	8	101		Flame	51	

\*None showed systemic manifestations on admission.

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at the time of the burn was replaced by a dull ache which lasted for a short time and then gradually disappeared. It may be that certain other types of burns not observed in the present series are accompanied by lasting severe pain, but this certainly was not true of the patients we observed. The possible dangers and misuse of morphine in severe injuries has been well discussed by Beecher.

Vomiting occurred in only 2 of the nonfatal cases and in neither of them did the vomiting interfere with feeding because it disappeared within 24 hours. In the fatal cases vomiting was more frequent; 6 of the 12 patients vomited, but in only 1 was it persistent (Case 51). Evidence of shock and toxemia was

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28	3-M	10	102-1	12	Normal	150	Flame	5 8	500 c c plasma
29	38-F	30	102-5	11	101	150	Flame	4 2*	500 c c plasma
30	21-F	40	104-2	12	100	90	Flame	8 0	1000 c c plasma (see text Fig 4)
31	16-M	20	101-2	12	100	90	Flash	5 2	500 c c plasma
32	6-M	6	None	10	Normal	54	Flame	None	
33	24-F	30	101-2	10	100	138	Flash	5 8	1500 c c plasma (see text Fig 5)
34	25-F	10	None	10	Normal	44	Flame	None	
35	9-M	12	101-3	9	100	124	Flash	None	
36	15-M	5	103-5	6	100	59	Hot water	None	
37	45-M	6	102-1	4	100	120	Flame	None	
38	4-M	6	None	10	Normal	102	Flame	None	
39	3-M	38	None	10	Normal	104	Hot water	None	
40	7-M	30	104-1	13	101	—	Flash	8 0‡	1000 c c plasma (see text Fig 6)
41	1/2-G	40	104-1	7	102	120	Flame	5 6‡	250 c c plasma
42	28-F	30	103-1	8	101	340	Flame	None	7 mo pregnant Aborted 24 hrs
43	2-F	12	101-2	5	101	—	Flame	None	

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## SURGERY, GYNECOLOGY AND OBSTETRICS

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								61	500 c.c. plasma
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4	1-M	20	100-2	14	Normal	26	Hot water	525	
5	1-M	40	102-1	13	Normal	36	Hot water	82	See Fig 1
6	3-M	30	102-1	6	101	39	Hot water	None	
7	6-F	19	None	13	Normal	15	Hot water	52	
8	2-M	20	104-1	6	101	18	Flame	None	
9	9-M	10	None	14	Normal	14	Flame	68	See text Fig 1
10	40-F	40	None	11	Normal	28	Flame	58	500 c.c. plasma
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15	3-M	12	102-2	12	Normal	28	Hot water	None	
16	39-F	15	None	9	Normal	13	Hot water	None	
17	1-F	30	102-1	8	101	17	Hot water	None	See text Fig 3 1500 c.c. plasma
18	51-M	45	100-4	5	Normal	59	Hot water	55	
19	5-F	10	None	5	Normal	18	Hot water	None	
20	7-M	30	None	10	Normal	63	Hot water	None	
21	5-F	40	100-2	13	Normal	22	Hot water	None	
22	1-M	15	None	5	Normal		Hot water	None	
23	10-M	20	None	9	Normal	13	Flame	None	
24	11-M	15	None	10	Normal	15	Hot water	None	
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32	6-M	6	None	10	Normal	34	Flame	None	
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36	1½-M	5	103.5	6	100	59	Hot water	None	
37	45-M	6	102.1	4	100	120	Flame	None	
38	4-M	6	None	10	Normal	102	Flame	None	
39	3-M	38	None	10	Normal	104	Hot water	None	
40	7-M	30	104.1	13	101	—	Flash	8.0‡	1000 c.c. plasma (see text Fig. 6)
41	½-T	40	104.1	7	102	120	Flame	5.6†	250 c.c. plasma
42	28-F	30	103.1	8	101	340	Flame	None	7 mo pregnant Aborted 24 hrs
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TABLE III.—BURNS WHICH ENDED FATALLY

Case	Age, sex	Extent* (% body surface)	Systemic manifestations on admission	Highest T (°F.)	Time of death (after admission)	Thermal agent	Hemoconcentration Highest RBC (mill/c mm.)	Remarks
44	35 F	36	None	103	108 days	Flame	58	Pt. had multiple sclerosis. Died after transfusion reaction. R <sub>1</sub> 3000 c.c. plasma, also whole blood and red cells
45	70-M	62	None	102	7 days	Flame	78	1500 c.c. plasma
46	17-M	56	None	102	30 days	Flash	63	1000 c.c. plasma
47	43 M	90	Shock Toxemia	99	4 days	Flame	77	1000 c.c. plasma
48	57-M	100	Shock	97	3 hours	Flame	53	500 c.c. plasma
49	2 F	100	Shock	97	5 hours	Flash	7	500 c.c. plasma
50	2-M	20	Shock	99	6 hours	Flame	605	
51	3-F	20	Shock	100	24 hours	Flame	61	Died during plasma transfusion
52	42-M	75	Toxemia	100	12 days	Flame	815	6000 c.c. plasma
53	2 F	30	Toxemia	99	2 days	Flame	52	500 c.c. plasma
54	53-M	40	None	103	14 days	Flame	None	500 c.c. plasma 1000 c.c. whole blood
55	4 F	75	Shock Toxemia	101	6 hours	Flame	73	750 c.c. plasma

\*Estimate only approximate in patients dying soon after admission

or 3 days, invariably become infected, and act as a portal of entry for bacterial invasion.

The depth of the burn was also difficult to predict by inspection alone even at the time of the first dressing. By experience, however, it was soon obvious that the kind of thermal agent was of primary importance. For example, hot water seldom produced full thickness burns, only 2 out of 21 in this category requiring skin graft. Moreover, if one consults Table I, listing the burns which required no skin grafting, 19 of the 26 were due to hot water. On the other hand, in Table II, listing those which required skin graft, in all but 2 of the 17 cases a flame or flash was the responsible thermal agent. It should be emphasized, however, that 7 of the flame burns healed without skin graft, even though in 4 of them the burn had involved 25 per cent or more of the body surface (Cases 1, 10, 11, 26). It was also observed that even in extensive flame burns requiring skin graft the area was frequently smaller than expected. This seemed directly connected with the absence of infection and with the fact that the patient maintained a good nutritional intake from the beginning. Entirely apart from the food in-

take during treatment, the nutritional status of the patient at the time of injury also played an important part in the extent of skin requiring graft. Many of the burned patients were obviously malnourished and in them the depth of the burn always seemed to be much greater than in healthy individuals.

*Type of ointment.* Observations made with various types of greasy ointments showed in general relatively little difference even when similar areas were compared. However the best results seemed to follow the use of a water soluble carbowax ointment made up according to directions supplied by Dr. F. L. Meleney. Comparisons were also made between petrolatum-impregnated gauze and dry fine mesh gauze. In general, the latter, placed next to the skin, was followed by a drier wound but removal was more difficult and painful. Petrolatum, if applied sparingly in fine mesh gauze, proved fairly satisfactory; however, if an excessive amount of it were applied, which was more likely if coarse mesh gauze were impregnated with it, there was much more maceration of tissue and evidence of irritant action, as shown by greater discharge and apparently more necrosis.

**Incidence of infection.** The most striking observations made in the present series of cases was the relatively low incidence of infection. This was obvious at the time of the first change of dressing even when a period of 2 weeks had elapsed. In many cases the burned areas were dry and healed. Even when the skin showed moist necrosis there was rarely any pus or cellulitis. This low incidence of infection is also shown by the relatively low incidence of fever, which is shown in the tables herewith presented. For example, 19 of the 43 healed cases showed no fever at any time and 29 no elevation above 101 degrees F. More striking was the fact that at the time of the first change of dressing only one patient had a fever of 102 degrees F. or above, only 8 had 101 degrees F., 7 had 100 degrees F.; in 27 of the 43 the temperature was normal.

Another of the advantages of infrequent dressings was a reduction in the amount of routine nursing and professional care. This made it possible to employ the available nursing service for other purposes, notably maintenance of a good fluid and food intake, psychotherapy, and early movement and ambulation of these patients.

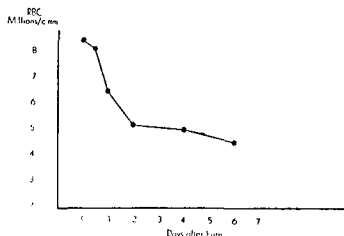


Fig. 1. Case 6. Three year old male, hot water burn involving 30 per cent of the body surface, which healed without skin graft. Note pronounced hemoconcentration on entry and its prompt subsidence without parenteral fluids. There were no systemic manifestations at any time except moderate lethargy for the first 24 hours. Fluid and food intake excellent from the beginning.

**Parenteral injections.** Only 10 of the 43 patients with healed burns were given plasma or blood transfusions as part of their early therapy, and of these 9 had flash or flame burns. Many extensive burns healed completely and satisfactorily without the use of plasma. This was true particularly of hot water burns, even when the red count was

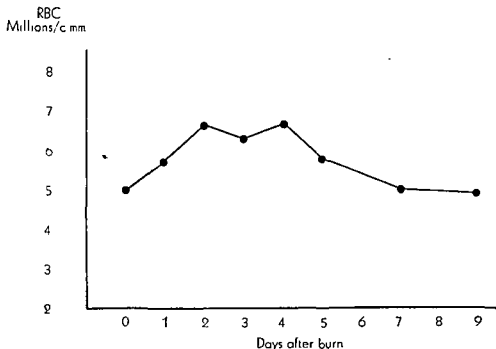


Fig. 2. Case 10. Forty-nine year old female, flame burn involving 40 per cent of the body surface, which nevertheless healed without skin grafting. Note the slow appearance of moderate hemoconcentration, which reached its maximum only after 48 hours and disappeared slowly by the 7th day. No parenteral fluids were used, but the patient took a high caloric, high protein diet from the beginning.



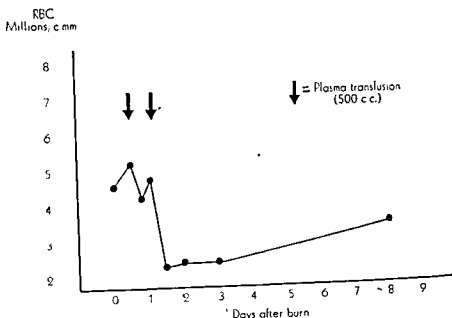


Fig. 3. Case 18. Fifty-one year old male, hot water burn involving 45 per cent of the body surface, which healed without skin graft. Note the prompt correction and probable overcorrection of hemoconcentration following two plasma transfusions. The anemia showed some spontaneous correction but was subsequently treated with whole blood transfusions. The general condition was good throughout the hospital stay.

significantly, and once greatly elevated (Figs. 1 and 2). The effect of plasma in correcting the hemoconcentration is well demonstrated in several cases shown in these figures. It should be mentioned, however, that 2 of the fatalities (Cases 50 and 51) might have been avoided had plasma been given or repeated, although in both patients pulmonary complications may have contributed to the fatal outcome. It should be noted that when plasma was needed large volumes were usually used. For example, in Case 52, 6 liters were used before the level of the red count remained normal.

**Rapidity of healing.** As compared with our previous experiences, the patients in the present series, even many with extensive burns, healed more rapidly and required less skin grafting. This seemed undoubtedly the result of the relative decrease in infection; infection itself is known to convert second degree into third degree burns, and thus increase the number requiring skin graft. It was striking that several of the extensive, fairly deep burns healed spontaneously or required only a small skin graft. Perhaps of equal importance in the rapidity of healing, as

already mentioned, was the high nutritional intake. On several occasions, patients whose nutrition was particularly well maintained by a high food intake had deep burns which looked as if they would require extensive skin graft, but which healed spontaneously without contracture, or needed only small coverage.

**Removal of slough.** The results in this group of patients were unsatisfactory and accounted for the long period of hospitalization, as shown in Table II. It is probable that further research will improve the present methods.

**Anemia.** Anemia was observed in only 8 of the 55 cases. In 6, the anemia was only moderate; the lowest count was between 3 and 4 million. In only 2 cases did the red count fall below 3 million. Three of the 8 cases resulted fatally, and this included one of the patients with a count under 3 million. On the other hand, the patient with the lowest red count, 2.4 (Case 18) recovered uneventfully. Whole blood transfusions as well as packed or suspended red cells were used in all of these cases, but not as an initial form of therapy. Inasmuch as anemia was not found during the first 24 hours, and in only 1 case (Case 18, which recovered) as early as the second day.

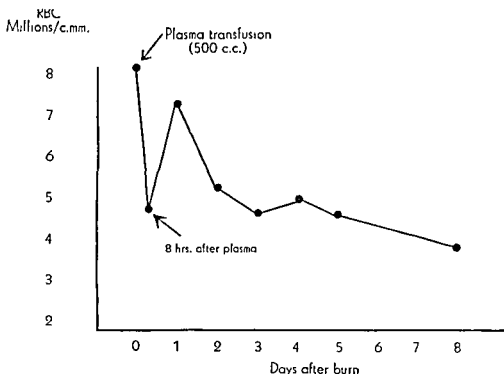


Fig. 4. Case 30. Twenty-one year old female, flame burn involving 40 per cent of the body surface requiring some skin grafting. Note the hemoconcentration on admission which responded promptly to a plasma transfusion only to recur within 24 hours. Spontaneous correction occurred thereafter, undoubtedly aided by an excellent fluid and food intake by mouth.

**Blood chemical changes.** Plasma protein determinations were made in many of the patients but will not be summarized in this report. Frequent red cell counts or hematocrits were made and form the basis for many of the graphs presented herein. The non-protein nitrogen of the blood was determined in many cases and frequently was found to be elevated, returning to normal with satisfactory progress of the case. In two of the fatal cases the rise was progressive until death.

**Fatal cases.** Inasmuch as the saving of life comes first in treatment, failure to do so under the present plan of treatment deserves special analysis. Scrutiny of the 12 fatal cases listed in Table III indicates that 6 of them were flame burns which involved 60 per cent or more of the body surface and might therefore be said to be fairly hopeless from the start. In spite of this, one of these patients survived for 7 days, another for 4 days, and a third for 12 days, the 3 others dying within a few hours after admission. The remaining 6 fatal cases might perhaps be called preventable failures. In 1, the patient died 3 months after the burn

following a fatal (Rh?) transfusion reaction. In another (Case 46) the patient survived for 30 days even though the burn involved 56 per cent of the body surface. Progress was satisfactory even though tetanus developed (in spite of the prophylactic injection of serum on admission) and apparently responded well to therapy. While it may have been partly the cause of death, the presence of an old Pott's disease of the spine suggested that miliary tuberculosis may have developed terminally. In another case involving 40 per cent of the body the patient survived 14 days (Case 54). This patient presented great difficulty throughout his hospital stay, largely because of repeated hemorrhage from the burned area. The burn was quite severe, inasmuch as the deep fascia was exposed at numerous places. Bleeding might have been due to hypoprothrombinemia. Unfortunately, no observations thereof were made. Another fatal case involving only 30 per cent of the body occurred in a 2 year old female who lived only 2 days (Case 53). The patient entered somewhat stuporous and this increased until the time of death without any fever. Respirations were

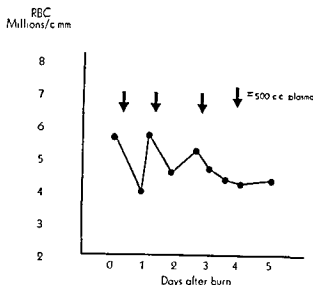


Fig. 5. Case 33. Twenty-four year old female, flash burn involving 30 per cent of the body surface, requiring some skin grafting. Complete healing by the 44th day. Note the persistent hemoconcentration permanently corrected only after three plasma transfusions.

labored and it was assumed that severe pulmonary damage had occurred, inasmuch as the child had been trapped in a burning house and undoubtedly inhaled a good deal of noxious gases as well as actual flame.

The remaining 2 cases (Cases 50 and 51) more than the others may be said to represent preventable failures in so far as the use of more plasma may have made a difference. However, pulmonary damage may have been partly responsible for the fatal outcome inasmuch as both patients were burned in the same accident, an explosion which occurred in a closed room and undoubtedly made inhalation of heated gases inevitable. Autopsy was done in only 1 case, but showed inflammation and deposition of soot down as far as the bronchi, as well as other evidence of pulmonary injury. Symptoms of circulatory impairment were present on admission in 1 case, but responded dramatically to a plasma transfusion, only to recur during the night. It was assumed to have been present for many hours before the second transfusion was started, because the patient died before very much plasma could be administered. In the other case (Case 50) surgical shock appeared only several hours after admission, and the patient died before transfusion could be started.

The frequency of vomiting, evidence of shock and toxemia in the fatal cases, should emphasize the importance of these clinical findings. These manifestations in many cases proved a more significant indication of the seriousness of the burns than the extent of skin involved. Moreover, all of the fatal cases were flame or flash burns. These factors are emphasized because they suggest that special study and treatment be accorded such patients from the beginning in order to save more of them if possible, particularly those involving a relatively moderate extent of the body surface.

#### COMMENT

On the basis of the present and previous studies, it has become increasingly evident that the systemic manifestations in severe burns including hemoconcentration, sensorial changes, circulatory impairment, and even fever and renal damage vary tremendously from case to case. Moreover, it seems clear that any attempt to correlate these differences with the degree of tissue damage must be based on more information than that given in the usual designations of extent of body involved and the terms first, second, and third degree burns. It would seem worth while evaluating carefully in each case the actual nature of the burn stimulus as well as its probable duration. The type of skin damage produced by various thermal injuries has received little study, particularly in fatal cases in which complete microscopic study of the skin is possible. Such information is needed if we are to explain the great variations in the systemic effects of severe burns and to save more of the fatal cases with as simple and effective therapy as possible.

Variations in the actual thermal injury may be classified into at least three groups: (1) The degree of temperature of the thermal agent may vary from 70 degrees C. in a hot water burn to several thousand degrees in a flash burn. (2) The duration of the increased temperature varies from a fraction of a second in some flash burns to many seconds in the case of hot water or flame; it undoubtedly lasted many minutes in the case of the victims trapped in the Cocoanut Grove or Hartford

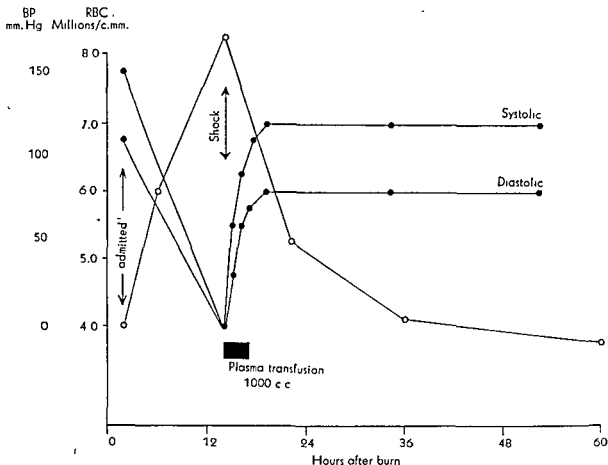


Fig. 6. Case 40. Seven year old male, flash burn involving 30 per cent of the body surface. Note that on admission there was absence of hemoconcentration and definitely elevated blood pressure. The general condition was good. After 12 hours typical surgical shock developed with cold extremities, rapid pulse and unmeasurable blood pressure. This was accompanied by hemoconcentration. A rapid plasma transfusion of 1000 c.c. (30 c.c. per kilogram) effected a dramatic clinical improvement, and as shown in the chart, a prompt restoration of blood pressure and correction of hemoconcentration. Skin graft was eventually necessary. ●—●, Blood pressure; ○—○, red blood cells.

circus fires. (3) The part of the body involved also contributes to variations as, for example, the relative resistance of the face as compared to the hands, due undoubtedly to the differences in their blood supply and tissue tension.

Classification according to the thermal agent itself, e.g., flame and hot water burns, may explain many of the differences. For example, in the present series none of the 21 hot water burns proved fatal and only two required skin graft, yet a third of them involved 30 per cent or more of the body surface. Moreover, more of them exhibited hemoconcentration than did the flame and flash burns. Nevertheless, all of the fatal cases were flame and flash burns and all but one showed hemoconcentration. In contrast to the relative infrequency of skin graft even with extensive hot water burns, two thirds of the surviving flame burns required skin graft even though

many involved small areas of the body. In spite of the frequency of hemoconcentration in the hot water burns the incidence of fever was less pronounced, i.e., half of them showed none during their entire stay. By contrast, only a third of the flame and flash burns were afebrile during their entire stay. It should be emphasized that fever was only occasionally associated with other manifestations of infection; in most cases it was probably due to absorption from devitalized tissue or extravasated serum.

The satisfactory results which can be obtained with the simplest of dressing were well demonstrated in the present series of cases. Despite the hundreds of different ointments recommended for application next to the burned skin, it would seem that none is really required. Much more important is the meticulous avoidance of droplet and other

contamination during the dressing. The fundamental fact that much of the infection in burns can be traced to bacteria which reach the burn *after the patient enters the hospital* was established by Cruikshank over 10 years ago. Its truth and practical application in dressing burns seem amply shown in our findings.

The rather limited use of intravenous injections in the present plan of therapy, demands special scrutiny. While such treatment is always complicated and should be minimized as far as possible in formulating a simplified plan of treatment, it should never be withheld when indicated. The most absolute indication is, of course, the possibility in combating, in the severe cases, any tendency toward a fatal outcome. How can one tell? The present observations have certainly indicated that many extensive burns will undoubtedly heal promptly and satisfactorily without such intravenous injections. On the other hand, there is always the possibility that fatalities may result from such a policy. From our observations as reported herein it is evident that constant observation is necessary during the first 24 to 48 hours in any patient with a flame burn exhibiting such systemic manifestations as vomiting, severe sensorial depression, actual or incipient circulatory impairment. These manifestations are of grave import even when the burn involves but 20 or 30 per cent of the body surface. Individualization must therefore be an important feature of any plan of treatment. Close scrutiny of such cases will undoubtedly minimize the mortality. It is in this group of cases that special methods of treatment may be indicated. For example, the injection of sodium lactate or bicarbonate may prove to be of decisive importance (5,13,14). In subsequent patients with such severe manifestations we expect to study changes in the carbon dioxide combining power and the effect of introducing bicarbonate or lactate solutions. The preference for whole blood over plasma (1,9,14) even though hemoconcentration is present may also prove decisive in this group of patients. It would seem obvious, however, that no method of therapy can be evaluated when used in extensive burns which would have done just as well without them.

With special emphasis on these potentially fatal cases which we believe can be detected shortly after admission, routine care of severe burns need not involve complicated methods of treatment. This is an important practical consideration. If the routine case can be handled in a relatively simple manner, attention and effort can be more effectively concentrated on the more serious ones in order to answer some of the unsolved questions, particularly regarding methods of therapy designed to further reduce mortality.

#### SUMMARY

A series of 55 severe burns (covering 10 per cent or more of the body surface) were treated by the application of a simple gauze dressing, without preliminary débridement, but with meticulous aseptic care, and left in place as long as possible, often 2 weeks. Plasma transfusions were not used as routine, but only when indicated by circulatory impairment; as part of the early treatment it was employed in 10 of the 43 healed cases. Morphine was not used as routine, but only for the relief of pain in 9 of the 55 cases. A high fluid and food intake was an essential feature of therapy and was possible from the beginning by the oral route in all but a few of the severe cases. The clinical findings in the 43 healed cases were satisfactory and showed relative absence of infection, rapid healing, and required a relatively small amount of skin grafting.

Analysis of the systemic manifestations shows tremendous variation and suggests that the extent or depth of the skin involved is not always an accurate indication of its seriousness. Of great significance was the kind of burn, which should be described as flame or scald, and, when possible, in terms of the duration and temperature of the burn stimulus. Analysis of the fatal cases suggests that they may be detected early by the presence of vomiting, shock, toxemia. In the face of such manifestations even in nonextensive burns special therapy is indicated to reduce mortality further in these cases.

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# TECHNIQUE FOR THE REPAIR OF POSTOPERATIVE ABDOMINAL HERNIAS

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IT is not my intention to discuss the prophylaxis of postoperative abdominal hernia. The purpose of this communication is to discuss the surgical technique for the closure of the ring or opening when a hernia has unfortunately developed.

## ANATOMICAL CONSIDERATIONS

For the purpose of this discussion the abdominal wall may be considered as divided into two parts, an upper and a lower, the level of the umbilicus being roughly the dividing line.

Thus a cross section of the abdominal wall at the various levels may be comparable to a bow with a taut string in the upper and to a bow with a loose string in the lower (Fig. 1A and B).

In the upper abdomen the wall is firm and tense and the strong lateral pull of the abdominal muscles and their costal attachments frequently make closure of vertical incisions difficult. Every surgeon has experienced the annoyance of the sutures cutting the tissues when closing the posterior sheath of the rectus muscle. When a hernia develops

in this region, paradoxical as it may seem, the long axis of the ring is pulled transversely though the primary incision was vertical (Fig. 2A).

In the lower abdomen the wall is more lax, tends to bulge forward and downward, and in some cases becomes attenuated and even pendulous. Here the hernial opening is usually longer in the vertical diameter (Fig. 2B).

The linea alba is normally weaker in the lower abdomen. When a pendulous abdomen develops, usually associated with an umbilical hernia, the linea alba gives way to a point about 2 inches above the symphysis pubis. Professor I.M. Thompson, head of the department of anatomy in the University of Manitoba, stated during a discussion of this fact that: "The structures that reinforce the linea alba at this location are the pyramidalis muscles and their fibrous attachments to the linea alba and the reflected parts of the inguinal ligaments. These fibrous attachments undoubtedly prevent any further downward diastasis of the rectus muscles."

Furthermore, the diastasis of the rectus muscles stops abruptly above, at, or near the level of the umbilicus and this is where the lowest pair of the transverse intersections (linea transversae) of the rectus muscles is attached to the linea alba on each side. Thus with the distention limited above and below and laterally by the rectus muscles, the internal ring of a pendulous abdomen is well defined. These anatomical limits may be disrupted when a pendulous abdomen results from an incisional hernia.

## TECHNIQUE OF REPAIR

Taking into consideration the anatomy of the abdominal wall and the structural changes that occur, four methods seem applicable to the various types of hernias that follow abdominal operations.

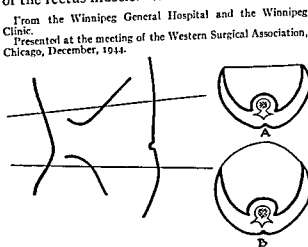


Fig. 1 Diagrammatic illustration of muscular tension. A, Upper wall. B, Lower abdominal wall

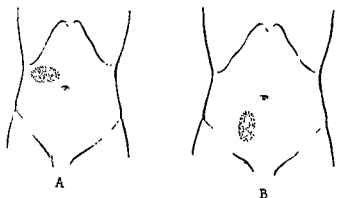


Fig. 2. Illustrating the shape of hernial ring resulting from muscular pull in A, the upper abdomen; B, the lower abdomen.

1. In the upper abdomen, the ring being longer in the transverse diameter, repair would logically be done transversely. This is applying the principle of the Mayo umbilical hernia operation to a postoperative hernia in this region. Arthur E. Benjamin has also applied this principle successfully in his work in suitable cases. I have frequently split the upper (usually the thicker) margin of the ring into two flaps and sewed the lower edge between them, thereby making stronger union (Fig. 3). As the posterior flap of the divided upper margin is necessarily sewed to the posterior surface of the lower there is less likelihood of omentum worming in between stitches as pointed out by Elliott Michelson and William Raffel.

2. In the lower abdomen the wall being more lax the problem of closure therefore is quite different. Here the hernial ring is a vertical oval and closure should be done vertically. The lateral margin of the ring, the

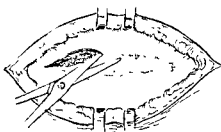


Fig. 3. In the upper abdomen repair is done transversely by overlapping the edges or splitting the upper and sewing the lower between the flaps formed.

thicker of the two, is split and the medial margin is stitched between these two lateral flaps, three layers thereby closing the opening (Fig. 4).

3. At times the hernial opening is very large, as if the whole incision had separated and neither transverse nor vertical sewing seem to suit the case, the tension in the center being too great. In this event I have found the following expedient useful. Sewing is begun at the lowest point of the ring or opening and is continued upward to a point where tension is not too great and the sutured part can meet with the upper segment of the ring (Fig. 5A). The remaining part of the opening is then closed transversely resulting in a "T" shaped suture line (Fig. 5B).

In rare instances this procedure may be reversed, sewing beginning at the uppermost point of the opening. Only once in a very high hernia, following a paramedian incision which had completely disrupted, I found this latter method to be the only one that seemed suitable in this particular case (Fig. 6B). Where

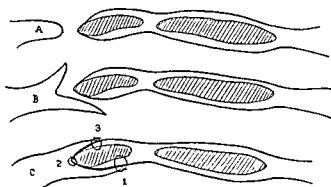


Fig. 4. Lower abdomen. A, Hernial defect. B, Lateral margin is split. C, Medial margin is sewed into the lateral cleft. The suture lines are not directly superimposed and they have a buffer layer between them.

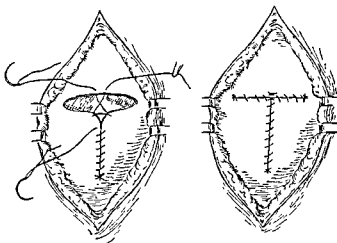


Fig. 5. A large circular ring may be closed by a combination of A, left, vertical; B, transverse sewing.



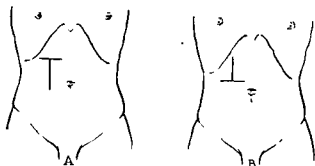


Fig. 6. Closure of a large ring partly from below upward A, or from above downward; B, depending on the muscular pull and ending the closure transversely. Only in an exceptional case would the second procedure be applicable.

overlapping cannot be done, figure-of-eight reinforcing stitches are used. These stitches are tied over a Wetherbee plate as this plate assures no give and there is no drag on the skin. If the stitches are tied without tension cutting or necrosis of the fascial edges should not occur (Fig. 7). These stitches remain in 14 or more days.

I would like to point out here that dissecting out the anatomical layers which have become fused together from the primary operation, as some advocate, is inadvisable. To do so prolongs the operation, unnecessarily traumatizes tissue with poor circulation and furthermore suture material is necessarily superimposed one row upon another which does not favor good healing.

4. In long standing cases in the lower abdomen the wall may be, as already mentioned, attenuated or even pendulous, especially if



Fig. 7. Reinforcing figure-of-eight silk worm gut stitches tied to Wetherbee plates. The ends of two parallel stitches are tied together at one side of the plate and the opposite ends on the other side. The stitches do not pass over the skin wound or the plates. It is best to use double strand stitches.

the rectus muscles have become atrophied from the severing of nerves. For this type the three flap operation for the extreme pendulous abdomen that I described before this Association in 1917, seems best suited (3). The operation was originally designed for cases in which an umbilical hernia had piloted the protrusion so that the umbilicus (and its hernia) was no longer in its normal position in front of the abdomen but was 15 or 16 inches farther down

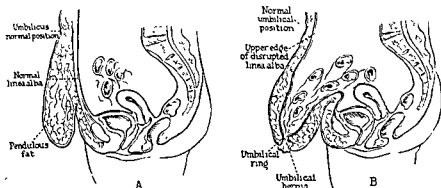


Fig. 8. Pendulous abdomen. A, Simple pendulous fat (panniculus adiposus). Note the abdominal wall is intact. B, The linea alba has gradually stretched into a funnel-like process. An umbilical hernia is at the apex, having descended far from its normal position. The funnel-like tubular process is filled with small intestine and omentum. Note: The defect does not reach the symphysis below and only to the normal umbilical level above. This is not a postoperative condition.



## SURGERY, GYNECOLOGY AND OBSTETRICS

there is marked diastasis of the rectus muscles. This would necessarily apply to a hernia in the midline at or below the level of the umbilicus, but also it is applicable in hernias lateral to the midline where the ring is large and the wall thinned out and bulging.

The preoperative and postoperative treatment needs stressing. Preoperative preparation is directed toward (1) reducing distention, (2) reducing weight, (3) cleaning and sterilizing the operative field, and (4) treatment of avitaminosis and any secondary anemia. This preparation may in some cases take as long as 3 months.

The postoperative treatment consists of (1) flexion of abdominal muscles with pillows (not a straight back rest), (2) nasal gastric suction in all cases until the stage of distention is past and the early use of rectal tube and the judicious administration of prostigmine and pitressin, and (3) surgical fluids *per os* for 4 days or longer if necessary.

## RÉSUMÉ

1. The type of operation for the repair of an incisional hernia varies for each case and

has little to do with the type of the primary incision.

2. The shape of the hernial ring will determine whether closure shall be vertical or transverse.

3. Dissecting out the individual primary layers is unnecessary and complicates the operation. Overlapping is preferable or splitting the thicker edge with overlapping and underlapping is to be preferred. The simpler the procedure the better.

4. A large hernial ring may be closed by combined vertical and transverse suturing as described.

5. In a huge hernia with attenuated and pendulous abdominal wall the "Three Flap Operation" will, I think, be found most suitable.

6. Meticulous preoperative and postoperative treatment and care are a *sine qua non*.

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# ONE STAGE TUBED ABDOMINAL FLAPS

## Single Pedicle Tubes

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WAR wounds of the upper extremity involving extensive loss of soft tissue frequently require pedicle replacement of skin and subcutaneous tissue. The need for early coverage and the desirability of expediting the treatment of a large number of cases has emphasized the usefulness of the direct abdominal flap for this purpose. Single pedicle abdominal flaps may be applied to any defect of the hand or forearm as a one stage procedure. The open pedicle flap as frequently used has the disadvantage of a contaminated wound requiring secondary closure. Any open wound of the hand impairs the return of function. Therefore, it is desirable to convert the donor area and base of the pedicle into a closed wound. This also diminishes the dressing problem and the possibility of infection at the time of division. The donor site may be sutured primarily or covered by a split thickness skin graft. In either case the base of the pedicle may be grafted. Whenever possible, the authors have closed the donor site as a linear incision, a simpler and more direct method which minimizes the subsequent deformity. The desirability of closing the base of the pedicle as well as the donor site has led to an endeavor to combine the advantages of the closed tube with the advantages of the direct abdominal flap. This has been successfully done in 31 cases by constructing one stage tubes, 25 of which covered defects of the hand and wrist.

It is possible to raise large, long, oblique, or vertical flaps from the lower abdomen and still close the donor area because of the greater mobility of the tissues in this region. When based inferiorly an excellent blood supply is assured by including the superficial epigastric and superficial circumflex iliac veins and accompanying arteries. These characteristics

of size and viability permit easy tube formation. When combined with the adaptability of the hand to various positions, the usefulness of these tubes for covering irregular defects of the hand becomes apparent.

Single pedicle tubes, based inferiorly, including the superficial epigastric veins have been constructed, varying in length from 5 to 18 centimeters and varying in width from 3 to 7 centimeters. Exact limitations of size have not been determined. The dimensions depend on the size of the defect to be covered and on the obesity and mobility of the abdominal tissues. The superficial veins can usually be seen through the skin and are used



Fig. 1. Infra-red photograph showing superficial epigastric veins (left), and donor area where tube was recently detached (right).

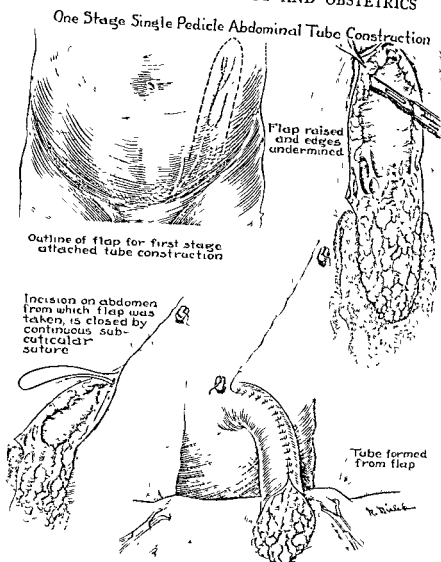


Fig. 2. Diagram of tube construction showing inclusion of superficial epigastric veins, undermining of margins for closure of donor area, and closure by continuous subcuticular stainless steel wire suture.

as a guide in outlining the flap. If the veins are not visible their approximate location can be estimated.

The flap is outlined on the abdomen as two parallel incisions tapering to a blunt point superiorly. It is raised either just superficial to Scarpa's fascia or may include the fascia. The margins of the donor defect are undermined for closure in the fatty areolar layer beneath the fascia. Additional relaxation may be obtained by incision of the fascia parallel to the skin margins. The attachment of the flap is extensively undermined to allow mobility in closing the angles when the base of the tube is formed. The donor defect is closed with

continuous subcuticular stainless steel wire. This procedure has proved to be a rapid, simple, and satisfactory method of closure and incorporates the basic principle of using a buried subcuticular suture for closing skin under tension. This continuous suture includes one or both angles of the incisions at the base of the flap and begins formation of the tube. By staggering the inferior ends of the incisions the base of the tube may be rotated through an arc of 180 degrees. If the medial incision is shorter the open surface of the tube will rotate laterally. If the lateral incision is shorter the tube will be rotated medially. The angle of rotation depends on

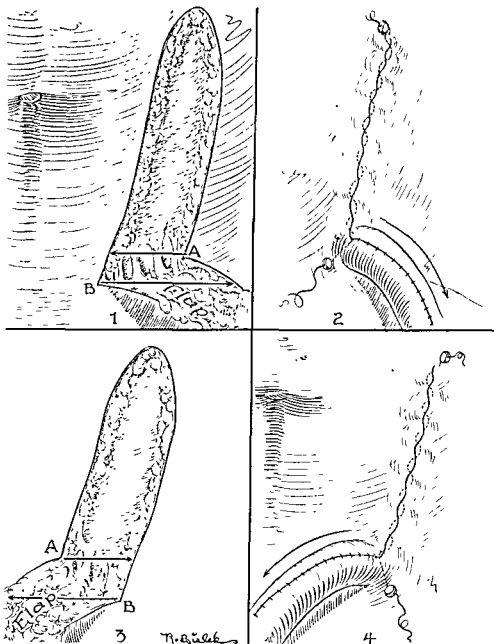


Fig. 3. Diagram showing rotation of tube to right or left, by staggering of incisions.

the amount of staggering of the original incisions and on the width of the flap. Thus the open surface of the tube may face medially, superiorly, or laterally, without twisting the tube itself. Combined with the fact that it may be folded on itself, application to the hand is permitted in a wide variety of positions.

The flap is formed into a tube by simple interrupted sutures and is applied to the recipient defect by subcuticular sutures of fine, white, twisted nylon and interrupted skin sutures of fine stainless steel wire or fine silk. The wire seems to give less reaction than does silk in the presence of moisture.

If the original defect is completely covered at the time of application, the tube may be handled much the same as is an abdominal flap and divided in about 3 weeks. However, if the tube itself is used to cover a portion of the defect, a longer period of time is allowed and some type of delay is advisable, depending upon the length of the tube. When the tube has a small application to the recipient area, as when it is attached to the wrist to be carried to some other portion of the body, or used in total thumb reconstruction, the time of application must be longer than when a double pedicle tube that has been constructed previously is applied. This difference in time we attribute



Fig. 4.



Fig. 5.



Fig. 6.



Fig. 7.



Fig. 8.



Fig. 10.

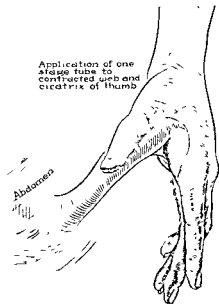


Fig. 9.



Fig. 11.



Fig. 12.



Fig. 13.

Fig. 4. Case 1. Preoperative view of severe scar and contracture which was present between the first and second metacarpals.

Fig. 5. Case 1. Postoperative view following excision of

scar, release of contracture, and application of one stage single pedicle tube.

Fig. 6. Case 1. Dorsal view of applied flap.

Fig. 7. Case 1. Palmar view of applied tube



Fig. 14.

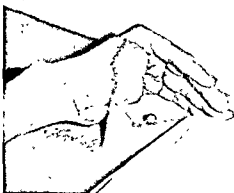


Fig. 15.



Fig. 16.

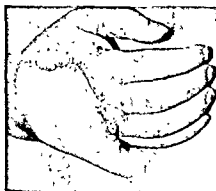


Fig. 17.



Fig. 18.



Fig. 19.

Fig. 8. Case 2. Web contracture associated with scar on palmar surface of amputated thumb.

Fig. 9. Case 2. Diagram of application of tube.

Fig. 10. Case 2. Postoperative view showing correction of contracture and application to thumb.

Fig. 11. Case 3. Tube to correct contracture after amputation of middle finger with palmar and dorsal scar.

Fig. 12. Case 4. Tube applied to wrist.

Fig. 13. Case 5. Tube applied to palmar surface of finger to correct severe flexion contracture. When the tube was divided the end was applied to correct the cicatrix of the amputated thumb.

Fig. 14. Case 6. Tube applied for reconstruction of thumb.

Fig. 15. Case 7. Tube applied to palm.

Fig. 16. Case 8. Another case in which the tube applied to palm.

Fig. 17. Case 9. Tube applied to dorsum of hand.

Fig. 18. Case 10. A type of flap in which tube formation may be a disadvantage. Because of the width of the attached margin, tube formation was not desirable and the base was covered by a split thickness skin graft.

Fig. 19. Case 11. Tube attached to wrist to be carried to another part of the body.

to the primary healing reaction and unestablished blood supply in the one stage tube. Compared with the double pedicle tube the time of application is longer but the total time is shortened.

Delaying tubes, which not infrequently have a border line blood supply, is best done as a closed procedure in order to prevent superimposed infection which may further impair the blood supply, in this manner forming a vicious cycle which may result in partial loss of the tube.

#### SUMMARY

One stage single pedicle abdominal tubes have been found a practicable and an advantageous method of applying skin and subcutaneous tissue to defects of the hand. They combine the speed of the abdominal flap with the cleanliness of the tube. When attached to the wrist they may be carried to other parts of the body.

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## THE EFFECTS OF CERTAIN DRUGS ON THE SPHINCTER OF ODDI

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**P**RESSURE changes in the biliary system secondary to variations in tone and states of contraction of the musculature surrounding the lower end of the common bile duct have been shown to occur in many animals and in man. Former investigations have demonstrated changes in intraductal pressure by measuring these variations, which have been relayed up through a cannula in the common duct and into a manometer system. Since direct observations of the sphincteric contractions of this muscle system had not been recorded, it was believed that their measurement might throw additional light on the reactivity of the sphincter of Oddi.

### LITERATURE

Oddi was the first to measure the intraductal pressure. He measured the tonus of the sphincter by observing the height of a column of water supported in a tube tied in the common duct. Doyon reversed this procedure by measuring the amount of fluid passing through the ampulla from a specially constructed manometer connected with the common duct.

The effects of external stimuli and diet on intrabiliary pressure have been studied by several observers. Archibald noted that touching the duodenal mucosa with hydrochloric acid or pinching it raised the tone of the sphincter so that pressures as high as 800 millimeters of water were recorded. McWhorter found that magnesium sulfate in the duodenum lowered the pressure produced by the tone of the sphincter from 50 to 100 millimeters of water. Jacobson and Gydesen observed that in addition to magnesium sulfate, acids and peptone lowered the sphincter tone. Cole found that isolated gastric contents influence the pressure variably. Bruno, Klodnizki, Boldyreff, and Rost observed in-

termittent gushes of bile from the ampulla of unanesthetized dogs which they interpreted to be the result of the relaxation of the sphincter. This observation has been confirmed many times by others (Puestow; Klee and Kluepfel).

Lueth studied the effects of various drugs on the intraductal resistance in the common duct and found that in general the effects on the intraductal resistance and duodenal tone were similar.

The pressure necessary to cause a flow of water from the common duct through the ampulla has been measured by many observers. In the dog it has varied from 60 (Winkelstein and Aschner) to 675 (Oddi) millimeters of water. In man most observers agree that the normal tonicity of the sphincter of Oddi varies between 90 and 150 millimeters of water (Butsch, McGowan, Walters; and Elman and McMaster, 9, 10). This resistance may be raised from 600 to 700 millimeters water under certain circumstances.

### METHOD

External biliary fistulas were prepared in dogs according to Puestow's technique. The major ampulla was transplanted to the skin after intestinal continuity was restored. The first operation consisted in an anastomosis such as is carried out in a posterior Polya resection of the stomach. When the dog had recovered, the closed duodenal loop was transplanted between the abdominal muscles and the skin. At the final operation, 7 to 10 days later, this loop was opened and cut across between the openings of the pancreatic and common bile ducts. The lower opening into the bowel was inverted and the skin closed over it. The edges of the upper opening were attached to the skin so that the ampulla was easily accessible. Over a period of months it was necessary to raise this portion as it tended to retract into the abdominal cavity.

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The dogs were fed on a standard diet with cereal and meat scraps. On this standard regimen they were kept alive for months. The two dogs on whom most of the readings were made stayed alive 215 and 250 days, respectively. The most dangerous complication exclusive of distemper was the opening of the lower loop, causing complete loss of pancreatic secretion, maceration of the skin, and a rapid downhill course. These dogs were thus kept alive with complete loss of bile except what they licked from the fistula. The mucosa around the fistula on manipulation bled easily, but only one dog showed any evidence of gross bleeding at autopsy.

After complete recovery the dog was strapped on his back on a table four or five times weekly for a half hour until he learned to lie quietly. All readings were made in the fasting stage. A small latex rubber bag with a hard tip and measuring 3 millimeters in diameter was inserted through the ampulla for a distance of about 2 centimeters. The proximal end was attached by glass and rubber tubing to the recording device. At first this method consisted of a rubber tambour and the conventional writing point on a smoked drum. The recorded excursions were so small that a more sensitive method which would increase the deviations was sought.

A photoelectric method by means of the electrocardiographic apparatus was devised. A beam of light separate from the electrocardiograph was reflected from a projection cell onto the photographic paper. Any variations in pressure on the rubber bag were transmitted to the cell, thus causing deflections of the light beam. A closed air system was used throughout the experiments. Since the speed of the photographic paper past the exposure slit was slowed by adding resistance in the electric circuit controlling the motion, variations in this speed were noted, caused by

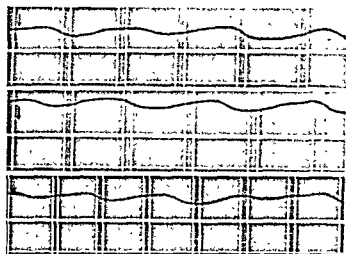


Fig. 1. First record, control reading; second record, following inhalations of amyl nitrite for 1 minute; third record, 5 minutes later.

changes in electrical resistance and friction of the rotating belt. To make the results comparable a timing device was added. A metronome was placed in front of the beam of light used in normal electrocardiography so that the moving pendulum would cut the beam. Because of the construction of the electrocardiograph the metronome could not be put exactly in front of the light beam, with the result that two vertical white lines close together caused by the metronome pendulum cut the light beam at the end of one and at the beginning of the next arc. Accordingly, the time interval between any comparable two lines is two seconds, the metronome being set at 60 oscillations per minute.

The curves shown on the photographic paper are the recorded contractions. The direction of the contractions is denoted by the arrow. The horizontal white line is the baseline used in electrocardiography and has no relation to the present records. No attempt for a standard baseline was made, since a "normal" or basal reading was taken at each period of observation for 10 to 15 minutes before any stimulus was used. Various stimuli

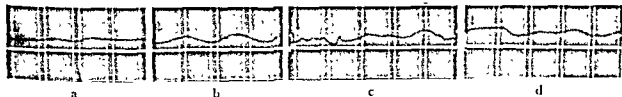


Fig. 2. First record, control reading; second record, following  $\frac{1}{4}$  grain morphine sulfate subcutaneously; third record, during vomiting. Note change in second time interval; fourth record, 5 minutes later.

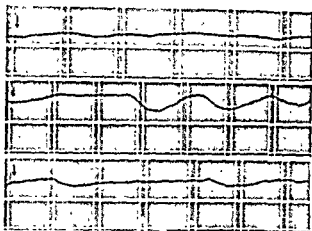


Fig. 3. First record, control reading; second record, following 1 cubic centimeter of surgical pituitrin subcutaneously; third record, 5 minutes later.

were used. Observations were limited to one a day so the effects of one stimulus would be gone when another was given. The stimulus was administered, an immediate reading taken, and a final reading again at 5 minutes. Repeat observations on the same animal under the same conditions were made as control procedures. The resulting curves were recorded, the paper was developed, dried, and representative portions were mounted on cardboard.

A standardization of the contractions showed that a difference of 1 millimeter on the recording paper equals 2 centimeters of water pressure.

#### OBSERVATIONS

**Normal.** A comparison of the control readings, i.e., those taken before any drug was given, shows that a slight rhythmic contraction occurs every 2 to 6 seconds. Each contraction was slow, taking from 1 to 2 seconds for the full variation in pressure to be recorded. These variations ranged from 2 to 7 millimeters, the average being 3 millimeters. During vomiting the pressure increased in one instance 12 millimeters or 24 centimeters of water pressure. This same change in pressure occurred in a much slower rhythm during excitement.

It is interesting that the "normal" or control readings vary from day to day in tone, rhythmicity, and number of contractions.



Fig. 4. Record taken during excitement.

**Calcium.** The dog was given 10 cubic centimeters of 5 per cent calcium chloride intravenously after a control reading was taken. There occurred a slight increase in tone, with no change in the amplitude of the contractions, and no change in the number of contractions.

Houssay and Rubio have stated that calcium chloride caused contraction of the gall bladder. Erbsen and Damm report that the calcium ion causes relaxation of the isolated guinea pig's gall bladder. The action of calcium on isolated smooth muscle is variable, although in the main it tends to cause relaxation. The results obtained here indicate that calcium increases the tone of the smooth muscle surrounding the lower end of the common bile duct.

**Novocain.** The topical application of 5 per cent novocain to the exposed ampulla had no observable effect on the tone, amplitude, or number of contractions.

**Adrenalin.** A subcutaneous injection of 1 cubic centimeter of 1:1000 solution of adrenalin caused an increase as high as 4 millimeters in the amplitude of the contractions, but no change in the tone or number of contractions. A dose of 2 cubic centimeters caused a still greater increase in the amplitude of the contractions to as high as 8 millimeters, an increase in the respiratory rate, and some restlessness in the animal.

Lueth reported a decreased duodenal pressure and intramural resistance after giving 1 to 5 cubic centimeters of 1:1000 epinephrine. With smaller doses the effects were inconsistent. In small doses the action on the gall bladder has been reported as variable. Larger doses caused contraction of the gall bladder. The amounts given in the present experiments were large, the effect being in proportion to the quantity of drug given.

**Amyl nitrite.** The dogs were caused to inhale the fumes of amyl nitrite for 1 minute.

The only effect on the state of the muscle tested was a slight decrease in tone (Fig. 1).

The effect of nitrites on smooth muscle is definitely one of relaxation. It is interesting, therefore, that while the tone of the muscle was reduced, the amplitude and number of contractions were unaffected. In view of the clinical relief which was obtained in patients with biliary dyskinesia, this finding was to be expected.

**Hydrochloric acid.** Tenth normal hydrochloric acid was applied topically to the ampulla as it lay exposed. The slight decrease in tone which occurred disappeared in one set of experiments and almost disappeared in the other during the observation period of 5 minutes. In one experiment the amplitude of the contractions increased slightly. Puestow noted a fairly constant stimulating effect on duodenal contractions and occasionally small spurts of bile occurred when dilute hydrochloric acid was applied. Elman and McMaster (9) noted a marked decrease in intraductal pressure when acid was introduced into the duodenum, while alkali caused a similar increase.

**Morphine sulfate.** One-sixth grain morphine sulfate was administered to the animal hypodermically. The frequency of the contractions increased slightly. The amplitude of each contraction increased from 3 to 6 millimeters, while a negligible change in tone occurred (Fig. 2).

Since morphine causes vomiting in dogs, several records during this action were taken. The musculature would relax until the actual vomiting occurred, when a sudden spasm would occur. Relaxation followed immediately. The time required for this was from  $\frac{3}{5}$  to 1 second. The pressure increased as much as 12 millimeters or 24 centimeters of water. No protracted spasm as reported by Butsch, McGowan, and Walters was noted. How much of this contraction was due to duodenal muscles could not be determined.

**Piluitrin.** One cubic centimeter of surgical pituitrin was injected hypodermically (Fig. 3). A definite and marked decrease in muscular tone occurred. The amplitude of the contractions increased up to 15 millimeters, while the number of contractions remained

about the same. The record also shows many smaller contractions occurring, about 6 to 8 per minute. These could not have been the effect of respiration, because the respiratory rate at the time was between 30 to 40 per minute. In comparison to the normal tonus rhythm they could be described as fibrillary contractions. They occur in some of the other records in a less marked variation and may be artifacts.

The decrease in tone agrees with the findings of Lueth, who found an initial decrease in intramural resistance followed by a slow return to the control level.

#### COMMENT

The intraductal pressure at the level of the sphincter is an aggregate of four components. These consist of the secretory pressure from the liver, the pressure dependent on the state of the musculature of the gall-bladder wall, the compression exerted by the muscle bundles, both circular and longitudinal, surrounding the lower end of the common duct, and the back pressure exerted from the lumen of the duodenum when the ampulla is patent. In the experimental set-up which is here reported, all except the compression factor of the sphincter and duodenal muscles have been eliminated.

In the operative procedure used in these experiments the circular muscles of the duodenum have been cut so that any remaining constricting action is a purely local contraction. The recorded differences then are caused more probably by the action of the sphincter, and the large changes in pressures reported by other observers have been due to the combined action of the duodenal musculature and the sphincter.

The greatest variation from the control pressure was 7 millimeters and the greatest variation under any circumstances recorded was only 15 millimeters, or about 30 centimeters of water pressure, as computed by standardization procedures. After similar operative procedures and cholecystectomy, Puestow reported 20 to 30 centimeters of bile pressure in the common duct. Ivy states that in the unanesthetized fasting dog the intramural resistance may vary from 9 to 25 centi-

meters of water pressure, depending on the length of the fast. This variation coincides with the present finding. These low pressures may have been the result of several things.

There is little doubt that most, if not all, of the vagal fibers were divided during the operative procedures. The sympathetic nerves around the hepatic artery remained intact, however. Since the exposed duodenal segment seemed to recover a normal tone, the ultimate effect of division of the vagus seems questionable. Under barbital anesthesia, stimulation of the peripheral end of the cut right vagus nerve in the neck caused an increase of 4 centimeters of water pressure. Stimulation of the central end of the right vagus and both ends of the severed left vagus had no effect upon the contractions of the sphincter.

In addition to the nerve section, the insertion of the bag through the ampulla may have partially paralyzed or fatigued the sphincter, so that complete recovery had not occurred before the period of recorded observations. If this is true, then the pressure differences recorded are only a fraction of the real changes which occurred.

The length of observation was usually about 30 minutes. In certain experiments there is suggestive evidence that the effects of the drugs became apparent only after the 5 minute interval. However, readings continued beyond this period became complicated by restlessness on the part of the dog, so that the criticism of possible incomplete observation must be accepted (Fig. 4).

In acute experiments with the ampulla raised to the skin and using the same pressure recording apparatus, a normal tone of 0.5 centimeter of water was found. This was a maintained pressure in spite of the barbital anesthesia. This procedure was not done on the unanesthetized dogs, but it seems reasonable to assume that the normal tone in those animals would be higher. Lueth found the pressure necessary to open the sphincter to vary from 3 to 5 centimeters of water, which is probably normal tonic resistance.

#### SUMMARY

In dogs with a biliary fistula preparation which excluded all pressure factors except

that which could be ascribed to the action of the sphincter of Oddi, studies of the changes in pressure in response to various drugs were carried out. The animals survived for many months (1 for 250 days) under normal conditions, so that observations could be carried out uncomplicated by anesthesia or trauma. In the fasting animal the bile flowed only rarely and the exposed segment of bowel was quiet. The sphincter normally underwent a more or less rhythmical slow contraction every 2 to 6 seconds, showing a pressure variation of 4 to 14 centimeters of water. The definite changes observed may be summarized as follows:

Calcium chloride administered intravenously caused a slight increase in tone.

Hypodermic adrenalin chloride, 1:1000 increased the amplitude of the contractions.

Topical 5 per cent novocain showed no effect.

Inhalations of amyl nitrite resulted in a slight decrease in tone.

Tenth normal hydrochloric acid applied topically caused a slight transient decrease in tone.

Morphine sulfate given hypodermically increased the number and amplitude of the contractions. A marked increase in amplitude occurred during the act of vomiting. This is interpreted as a defense mechanism against reflux of duodenal contents into the biliary system.

Surgical pituitrin hypodermically caused a marked decrease in tone and a marked increase in the amplitude of the contractions.

These results in pressure changes are comparable, though in decreased values, to those reported obtained by methods of cannulating the common duct. Because of the method here reported, it is believed that these pressures more nearly represent the action of the sphincter of Oddi.

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# LIPOSARCOMA OF THE FEMALE MAMMARY GLAND

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**L**IPOSARCOMA of the mammary gland is a rare tumor form in this organ, and the few cases which have been reported contain sparse and conflicting information about its degree of malignancy. Some of the metastases and causing death while others have pursued a much less noxious course. It is therefore by no means simple to decide how to treat liposarcoma of the breast when confronted with evidence of previously recorded cases, describe a new case, and discuss the question of treatment.

In Geschickter's monograph on diseases of the breast, mention is made without details of 3 women between the ages of 52 and 65 years, each of whom had rapidly growing breast tumors measuring 8 centimeters or more in diameter. All progressed rapidly to a fatal termination. He states that they can metastasize to the lymph nodes and that they are radiosensitive but not easily cured by this form of treatment. This exceedingly gloomy picture is duplicated by Lifvendahl's case. This was a 41 year old woman who noted small masses in both breasts. Three months later when she was examined there were 10 nodules in the left and 15 in the right breast. Bilateral mastectomy was done. The nodules were grayish-white and slimy. The largest measured 5 by 4 by 6 centimeters. Three months later she died with evidence of pulmonary metastases. It was an undifferentiated mucoid liposarcoma with many bizarre lipoblasts.

Adair and Herrmann cite briefly 4 cases from the Memorial Hospital, New York. Three of them were called myxoliposarcomas of low grade malignancy. One of these had numerous recurrences following simple mastectomy during a 10 year period and ultimately died of pulmonary metastases. Of the other 2 patients, one had local excision, the other radical mastectomy, and both remained free of disease respectively 4 and 4½ years after operation. The fourth patient was said to have had a "grade 4 liposarcoma" and lymphatic leucemia. She had no evidence of sarcoma 4 months after radical mastectomy.

Other cases have not pursued such a malignant course. Delage and Massabiau described a 52

year old woman who had a breast tumor weighing 1700 grams removed. It was called a myxolipoma. Six years later there was a recurrent nodule below the scar. Ten years after the first operation there were 5 nodules in the breast which the patient said felt like a bag full of oranges. A mastectomy was done and the tumors again called myxolipoma. Deaver and McFarland believe that this is in fact a case of liposarcoma and we agree with them. Neumann's patient was 60 years old. She had a slimy tumor in the inner hemisphere of the left breast. It was excised but recurred and 1 year later the new tumor was cut out. Recurrence followed and the third excision was done after 10 more months. It was a myxoid tumor with many cells containing fat droplets. In its last manifestation it was as large as an apple and reached but did not invade the corium. Neumann called it a myxoma lipomatodes but it seems proper to consider this also a liposarcoma of the myxoid type. Merkel's patient was 26 years old. She had a tumor at the margin of the gland which extended outside of it and in 6 months reached a size of 9 by 5.5 by 3.5 centimeters. It was encapsulated and had foam cells in it some of which were of giant size. Merkel called it a pseudolipoma but Borst saw the sections and considered it a true lipoblastic sarcoma. The final result is not recorded.

Fox's patient was 58 years old when a complete mastectomy was done because of an encapsulated tumor in the breast which had been present for 2 months. No metastases had been in the nodes and the patient was well 5 months later. It was called a liposarcoma but no other details are given. Cheate and Cutler also record the presence of a small liposarcoma in the female breast which looked like embryonal fat. The photomicrograph shows many rounded foam cells, some with large bizarre nuclei. No other details were recorded.

There are 2 other cases in the literature which seem to be examples of liposarcoma developing in the stroma of cystosarcoma phyllodes or adenofibrosarcoma. In Binkert's case a man's head sized tumor, weighing 3 kilos, grew in the left breast of a 39 year old woman in less than a year. A radical operation was done and axillary metastases were found. In 5 months there was a recurrence in the scar and metastases in the opposite

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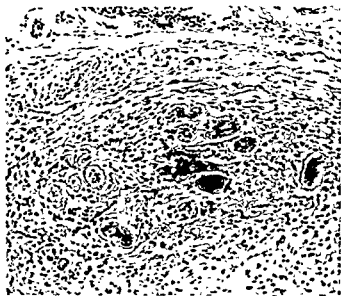


Fig. 1. Liposarcoma of the breast. Photomicrograph of the margin of the tumor showing infiltration around sclerosed ducts and acini.

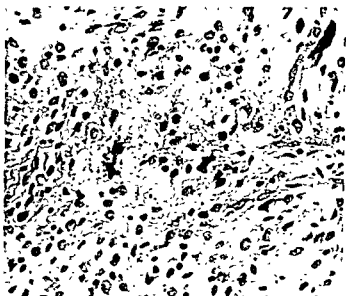


Fig. 2. Liposarcoma of the breast. Detail photomicrograph showing myxoid stroma and bizarre giant cells. Some of the cells are vacuolated.

axilla. A right radical mastectomy was done with removal of the nodule in the left-sided scar. The primary tumor was an adenofibrosarcoma (i.e. cystosarcoma phyllodes) with liposarcomatous stroma in places. The recurrence and metastases were liposarcomas with many bizarre giant cells but without epithelial elements. Binkert called the tumor a "fibrolipoadenoma intracanalicular sarkomatodes xanthomatodes mammae."

A case somewhat resembling Binkert's has been reported by Hinterberger. A 25 year old girl noticed a cherry sized tumor in her right breast which in a year attained the size of an orange. It was excised and during the next 6 years, 5 more operations for the removal of recurrences were carried out. The earlier tumors were fibroadenomas with sarcoma-like stroma. In the fifth specimen there was lipoblastic tissue between the recurrent sarcoma phyllodes nodules. The tissue from the last operation was studied in detail by Hinterberger. Now there was still a cystosarcoma phyllodes nodule but other nodules were lipoblastic tissue which invaded the surrounding mammary tissue. There were never any metastases observed. The final result is not reported.

It is of passing interest to note that liposarcomas have been described in the mammary glands of cats, dogs and guinea-pigs (Corsy and Thomas, Schultz-Brauns; lit.)

#### CASE REPORT

A married Jewess, aged 43 years, noticed a lump in the left breast on December 5, 1945. She consulted one of us (M.B.) about it the next day. Menstruation had been regular and the past history uneventful. Examination

showed a freely movable tumor 2.5 by 1.7 centimeters in the upper outer quadrant of the left breast. It was not attached to the skin and the axillary nodes did not feel enlarged. Roentgenograms of the chest and skeleton were negative. Sedimentation rate, Wassermann, and blood smears were normal.

Operation by one of us (M.B.) at the West Side Hospital on December 8, 1945, consisted of wide excision of the tumor and surrounding breast tissue. The wound healed well and there was no evidence of recurrence 2 months after operation. Gross examination of the specimen showed a mass of breast tissue 5 by 3 centimeters. Embedded in the center of this was a localized circumscribed tumor measuring 10 by 12 millimeters. It was soft, fleshy, and light brown in color.

Microscopic examination showed a tumor made up of a conglomeration of cells of varying size and shape, including round, spindle, and stellate forms and a number of bizarre multinucleated giant cells. These were set in a fibrous stroma some of the fibers of which were thick and others extremely delicate producing a myxoid appearance, although the mucicarmine stain showed no pink or red color. A schiarch R stain showed lipid droplets in some of the cells. The tumor was circumscribed but at its periphery invaded the surrounding breast tissue to a limited extent (Figs. 1 and 2). The tumor was considered a partly differentiated myxoid liposarcoma.

It is apparent from a study of reported cases that liposarcoma of the breast is a tumor which sometimes behaves in a most malignant fashion, metastasizing both through the lymphatic and blood streams and resulting in death. In other cases the infiltrative nature of the tumor is shown by repeated local recurrences after incomplete excision occasionally with a long free interval between excision and reappearance but without any metastasis, and finally there are cases apparently cured by adequate simple excision of tumor and surrounding breast tissue.



A study of a considerable number of liposarcomas led one of us (A.P.S.) to the conclusion that they could be divided into two main classes, those which show a considerable degree of differentiation and which do not metastasize as long as the whole tumor maintains its good differentiation and a second larger class which is poorly differentiated, may show various types of metaplasia, and which metastasizes in about 40 per cent of cases. A reasonable form of treatment for the first group was considered generous excision, because even if this was followed by recurrence, metastasis need not be expected; whereas in the second group, a more radical procedure should be carried out because of the potential danger of metastasis.

The case here reported was unusual because it was small and was generously excised within a few days of its discovery. It was felt that it could be placed in the more differentiated group and that therefore metastasis was extremely unlikely and that if local recurrence should occur after the generous excision of tumor and surrounding breast tissue, it would still be possible to do a mastectomy at a later date without jeopardizing the woman's ultimate chance of cure. For these reasons no further operative procedures were carried out. Had the liposarcoma belonged to the poorly differentiated group of liposarcomas, a radical mastectomy would have been the proper

treatment since such tumors may metastasize both through the blood and the lymphatic vessels.

#### SUMMARY

A new case of liposarcoma of the breast is recorded, previously reported cases are analyzed, and the treatment of this rare mammary tumor form is discussed.

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# DEFORMATIONS OF THE SKULL IN HEAD INJURY STUDIED BY THE "STRESSCOAT" TECHNIQUE, QUANTITATIVE DETERMINATIONS

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**D**EFORMATION of the skull due to hammer blows has been studied by the "stresscoat" technique (3). If the tensile deformations are of sufficient magnitude they cause cracks in a strain-sensitive brittle coating previously applied to the surface of the skull. The resultant deformation patterns may then be studied in the immediate vicinity of, as well as remote from, the region of the blow. "Stresscoat" (1,2) is the trade name of a brittle lacquer method of strain determination in any material subjected to static and dynamic loads. The surface of the structure is coated with a lacquer. Cracks form in this coating when the material to be tested is subjected to tensile strains of 0.0005 to 0.0015 inch per inch. The sensitivity of the lacquer depends upon the temperature and humidity conditions at the time of the tests. Different lacquers are used for varying temperature and humidity conditions. Before a test, the sensitivity of a given lacquer is determined by a calibrating device.

Dogs and monkeys were used in order to establish a correlation between the strain patterns obtained in the skull of the living animal under nembutal anesthesia, the skull of the dead animal with intracranial contents undisturbed and in the dry skull of the same animal (3). It was found that the patterns obtained in the dry skull were less extensive than in the skull of the dead animal or in the animal under anesthesia, but the direction and general distribution of the strain paths were the same in all 3 classes. It was justifiably concluded that the patterns obtained following hammer blows on the dry skull were similar to the findings in the living skull.

In the study of strain patterns in the human, dry and cadaver skulls were used. The effects of hammer blows on the midoccipital region near the parietal occipital suture, the midfrontal region, the anterior vertex at the midline, the lateral frontal, and the lateral posterior parietal regions

were studied (3). Following midfrontal blows, the strain paths extended toward the roof of the orbit, along the orbital rim, and toward the frontosphenoidotemporal junction at either side. With a midoccipital blow there were evidences of extensive deformation about the foramen magnum. Lateral frontal and lateral posterior parietal blows caused cracks in the lacquer extending toward the temple; with the former the direction of the cracks was downward and posteriorly, and with the latter downward and anteriorly.

It was found that the human and lower forms differed materially in their strain patterns. In the human the deformations detected by this technique were more localized. However, the value of the experimental animal in establishing correlation of results in the animal under anesthesia, in the skull of the dead animal with contents intact, and in its dry skull, was of inestimable value. It could be definitely stated that the patterns ob-

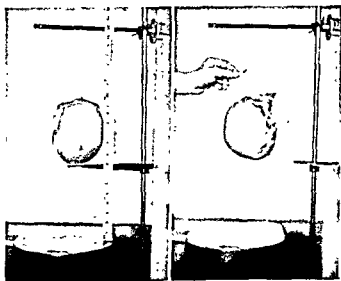


Fig. 1. This figure illustrates the method used for delivering known quantities of energy in certain locations in the skull. Before each experiment the skull is carefully weighed. It is then held at the proper distance from the steel plate to produce the desired energy at impact. The thread holding the skull is burnt with a match and following the impact the skull is caught on the rebound in order to avoid the possibility of secondary patterns from more bounces.

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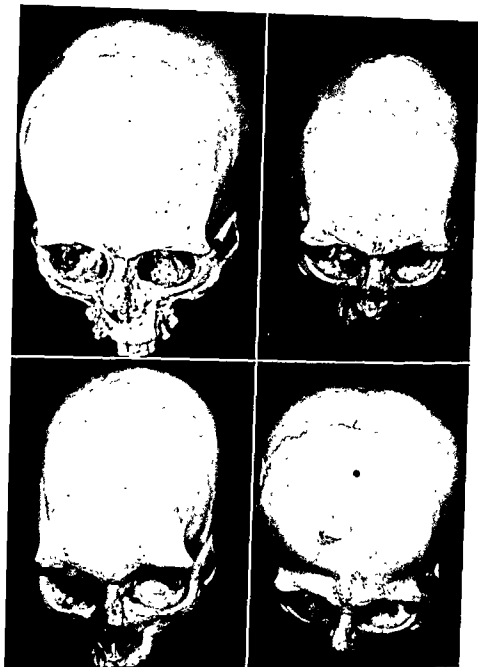


Fig. 2. The effect of 14.3 inch pounds of energy on the mid forehead. Upper left is skull G with sensitivity of lacquer at 0.00105 inch per inch. Upper right is skull C with sensitivity of lacquer at 0.00095. Lower left is skull B with sensitivity of lacquer at 0.00095. Lower right is skull D with sensitivity of lacquer at 0.00095. Note that there are minimal deformation patterns in each instance with the exception of skull B which shows no effects from the blow.

tained in the dry skulls were essentially the same as in living animals under anesthesia. This does not signify that the magnitude of the strains is the same, but that the strain paths are similar. It was also deduced with reason that the effect of the

skin and muscles on the strain pattern is negligible.

In the present paper certain quantitative data are given. The effects of a given amount of absorbed energy in various portions of the skull are



Fig. 3. Anterior vertex (midline) blow showing lines of strain extending toward the temple on both sides. This is skull B with sensitivity of lacquer at 0.00105 and with a blow of 14.3 inch pounds of energy.

described. Deformations resulting from blows of varying energy are also discussed.

#### PROCEDURE

Previous tests have shown that suture lines in dry skulls tend to interrupt the propagation of the cracks in the "stresscoat" lacquer. It was therefore decided to keep the skulls moist by immersing in normal saline solution between tests to prevent the disintegration of the tissue at the suture lines. One skull was permitted to remain dry as the tests progressed to determine any changes in deformation patterns resulting from the drying of the skull. Six human skulls, freshly obtained from the anatomical laboratories, and dissected free of soft tissues were used. Five were kept in normal saline solution, except when in use for strain determinations.

The skulls were removed from the saline solution in which they were stored several hours before coating in order to permit the excess moisture to drain off and evaporate. Just prior to spraying they were washed with ether. In no case was there any difficulty in getting the lacquer to ad-

here properly to the bone. The skull was first sprayed with a thin uniform undercoating of aluminum lacquer and after 15 minutes of drying a uniform coating of "stresscoat" lacquer was applied with a sprayer. Numerous calibration strips were coated at the same time. The lacquer was allowed to dry for 24 hours before a blow was administered.

In order that the results of tests made at different times could be correlated it was necessary to have the strain sensitivity of the lacquer within certain limits for all experiments. The range chosen was  $0.00100 \pm 0.00005$  inch per inch of strain to produce cracks in the lacquer. When the test was about to be made, one of the calibration strips was tried to check the strain sensitivity of the lacquer for the existing temperature and humidity condition of the room. If the sensitivity was too great, the room temperature was increased until a calibration strip test showed that the sensitivity was  $0.00100 \pm 0.00005$ . The skulls were then tested. A room with constant temperature and humidity condition would obviate some of the above described operations. However, with



Fig. 4. Anterior vertex (midline) blow in skull E with sensitivity of lacquer at 0.00105 and a blow of 14.3 inch pounds. Note that the pattern in this skull is somewhat more extensive than in skull B, Fig. 3.

the use of the calibration strips an accurate and quantitative determination can be obtained.

The skulls weighed from 1.07 to 2.23 pounds. They were dropped on to a polished steel block weighing several hundred pounds. Therefore the energy absorbed by the steel block was negligible. The amount of energy absorbed by each skull was determined by its weight and the distance through which it was dropped. The velocities at the instant of impact varied from 3.4 to 9.9 feet per second. Each skull was supported so that the blow was delivered perpendicular to a plane tangent to the point of impact.

A series of tests were made on the six human skulls with blows delivered to the midfrontal, midoccipital, lateral frontal, lateral posterior parietal, and anterior vertex (midline) regions. The skulls were suspended above the steel block with thread. For occipital blows the thread was tied to the bridge of the nose; for frontal blows, to a hook in the foramen magnum; for lateral posterior parietal blows, it was tied to the zygomatic arch; for vertex blows, the skull was supported by a thread tied to a hook in the foramen magnum, and for the lateral frontal blow it was supported

from a thread in the posterior parietal region tied to another tightly encircling the skull. The skull was then adjusted to the correct height above the steel block. The thread was burned, allowing the skull to drop on the steel block and it was caught on the rebound to prevent the formation of secondary strain lines in the lacquer due to additional bounces (Fig. 1).

The strain lines were next developed by coating the lacquered skull with red dye etchant. The excess etchant was removed with an emulsifier solution, leaving the dye only in the cracks. For purposes of photography each crack was then outlined with India ink. Faint cracks were gone over more lightly than heavy cracks which were stained with heavy lines of ink.

The formation of cracks in the lacquer indicated a minimum tensile strain of  $0.00100 \pm 0.00005$  inch per inch. The magnitude of the strain in certain portions of the area of cracks may be considerably in excess of the value given above. For instance, in the region of a strain pattern the cracks are closely spaced at the center and more widely spaced toward the periphery. It is evident that a strain gradient exists with the strain of the

peripheral cracks being about 0.00100 inch per inch and increasing in magnitude toward the more closely packed cracks in the center.

In a series of experiments the same amount of energy (14.3 inch pounds) was used in different locations of the skull. Another group of experiments were carried out in which the quantity of energy applied to different regions was varied from 8 to 24 inch pounds (Table I).

#### EXPERIMENTAL DATA

In Table I the weight of each skull at the time of a given test is tabulated. Skull B was kept dry and the other 5 were immersed in normal saline solution between tests. Only skull C shows a marked change in weight. This was caused by the separation of a portion of the intracranial contents which remained attached to the internal surface of the skull during the first two tests. It should also be noted that in certain experiments the skull weight was higher than in certain previous tests. This is almost wholly due to the varying amount of aluminum and lacquer coating sprayed upon the skull. Both are heavy and can cause differences in weight depending upon the thickness of the layer applied to the surface of the skull. The strain patterns in the skull not immersed in saline (skull B) were essentially of the same distribution and direction as those obtained from the moist skulls, but as the tests progressed a separation of the sutures gradually occurred and the results obtained after the sixth test were discarded. Such a separation not only may prevent the propagation of strain paths but it constitutes an area of energy absorption, causing quantitative errors in results. This is evident from the examination of the strain patterns obtained with 14.3 and 20 inch pounds of energy, Tests B-2 and B-8. In the case of this skull the strain cracks were less extensive for the higher energy than for the lesser value. It is felt that the most reliable results are obtained in fresh skulls which are kept moist in saline between tests. However, skull D, which was kept moist throughout the tests, had a separation of the lambdoid suture on the ninth test and was then discarded. The experimental data given were completed during a period of 3 months.

A constant energy of 14.3 inch pounds was used in all skulls in the first 6 experiments (Table I). Varying amounts of energy were used beginning with test 7. The findings will be described under (1) blows of constant energy, and (2) blows of varying energy.

*Results with constant energy.* The application of 14.3 inch pounds of energy by the above-described

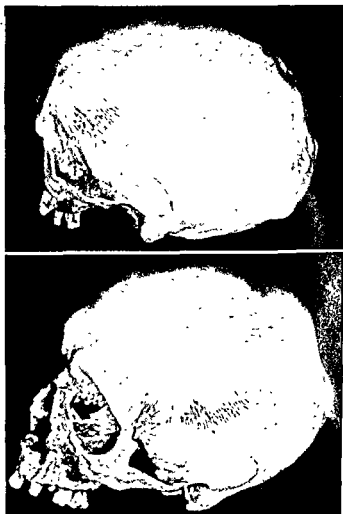


Fig. 5. Lateral frontal blow in skull E with sensitivity of lacquer at 0.00105 and a blow of 14.3 inch pounds of energy.

procedure resulted in patterns of different magnitude in different locations. Following an occipital blow the deformations were more extensive. With the same amount of energy midfrontal blows resulted in very slight change. There was also some difference in magnitude of patterns obtained with blows at the same location but in different skulls. Such variations from skull to skull may be explained in part by differences in shape, contour, and thickness, and slight change in the location of the blow in successive tests. These data will be described in greater detail in the next few paragraphs.

*Midfrontal blow with 14.3 inch pounds of energy.* These experiments were carried out on 5 skulls kept in saline and 1 dry skull. In Figure 2 it is noted that minimal strain cracks are found in the frontal bones in 3 of 4 specimens. In 1 (skull B), a blow of 14.3 inch pounds of energy caused no cracks in the lacquer with a sensitivity of 0.00095.

*Anterior vertex (midline) blow with 14.3 inch pounds of energy.* A blow in the anterior vertex at



Fig. 6 Lateral frontal blow on the right side in skull B with 14 3 inch pounds of energy and sensitivity of lacquer at 0.00105. In this experiment the skull fractured with line of fracture extending from the orbital rim to the middle of the area of impact.

TABLE I.— SKULL WEIGHTS AND DISTANCES DROPPED

Test No *	Skull											
	B†		C		D		E		F		G	
	Weight	Distance dropped	Weight	Distance dropped	Weight	Distance dropped	Weight	Distance dropped	Weight	Distance dropped	Weight	Distance dropped
1	1 10	22	1 73	8 1/4	1 18	12 1/8	1 47	9 1/2	2 23	67/16	1 75	83/16
2	1 16	125/16	1 72	85/16	1 17	12 1/8	1 38	10 1/8	2 07	65 1/8	1 62	813/16
3	1 17	123/16	1 37 1/2	107/16	1 20	11 15/16	1 38	10 1/8	2 05	7	1 63	81 1/4
4	1 18	12 1/8	1 31	10 11/16	1 19	12	1 35	10 1/8	2 04	7	1 62	813/16
5	1 18	12 1/8	1 25	11 1/8	1 07	13 1/8	1 36	10 1/2	2 03	7	1 59	8
6	1 18	12 1/8	1 27	11 1/8	1 12	12 3/4	1 41	10 1/8	2 00	613/16	1 61	81 1/4
7	1 18	12 1/8	1 27	7 1/4	1 16	8 1/8	1 40	7 1/8	2 03	8 1/8	1 61	75/16
8	1 10	10 15/16	1 25	6 1/8	1 16	6 1/8	1 36	14 11/16	2 09	8 1/8	1 61	11 1/8
9			1 31	123/16	1 17	13 11/16	1 39	75/16	2 08	5 1/8	1 65	611/16
10			1 20	14			1 43	14	2 11	0 1/2	1 65	110/16
11			1 28	15 1/8								
12			1 20	7 3/4								
13			1 12	183/16								

†Skull B, dry

\*Tests 1 through 6 constant energy tests (14 3 inch pounds), 7 through 13, variable energy tests

†The sudden decrease in the weight of the skull was due to separation of a portion of intracranial contents attached to the inner surface of the skull

Note Skull D, test D-9 On this test there was separation of lambdoid sutures

Skull B, test B-6 On this test there was linear fracture of the skull in the right lateral frontal region

Weights and distances in pounds and inches

made satisfactory recoveries. If cholangitis and obstructive symptoms develop after a reconstruction operation, one would best defer further surgical treatment unless definite complete obstruction is proved, as nearly a half of the patients who were reported well 2 to 12 years after operation had experienced transient cholangitis and symptoms of obstruction at one time.

On the other hand surgical treatment should not be withheld from patients on the grounds of a poor risk, for these 188 patients who underwent 496 operations, 257 elsewhere, underwent 188 procedures with only a 12 per cent surgical mortality rate.

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7. Posterior parietal blow in skull E with 14.3 inch pounds of energy and sensitivity of lacquer at 0.00100 inch h. Note the extensive deformations toward the phenoidfrontal junction

dline caused deformation patterns to ap-  
 along the lateral frontal and frontoparietal  
 n on both sides. There is some variation  
 ull to skull as concerns magnitude, but the  
 direction of the paths of strain are the  
 igs. 3 and 4).

l frontal blow with 14.3 inch pounds of  
 A blow in the lateral frontal region caused  
 tion patterns to appear in the parietol-  
 l region and the frontosphenoidotemporal  
 . The cracks extend down and poster-  
 ept near the zygomatic arch where their  
 is downward and forward. In Figures  
 re shown the strain patterns following a  
 ontal blow with a sensitivity of the lac-  
 0.00105 in both instances. Note that in  
 there are cracks in the lacquer covering  
 na.



Fig. 8. Occipital blow at the midline with 14.3 inch pounds of energy in skull E. Note the patterns over the squamous portion of the occipital and parietal bones. Note also the pattern at the base of the skull about the foramen magnum.

Lateral posterior parietal blow with 14.3 inch pounds of energy. Extensive deformations occurred with such blows. The paths of strain were downward and toward the "temple" (Fig. 7).

Midoccipital blow with 14.3 inch pounds of energy. A blow on the squamous portion of the occipital bone near the lambdoid suture at the midline caused some local deformations and deformations about the base of the skull at the foramen magnum (Fig. 8). In Figures 8 and 9 are seen differences in the magnitude of these strains, but the direction of the paths are the same. This may be in part explained by differences in skull

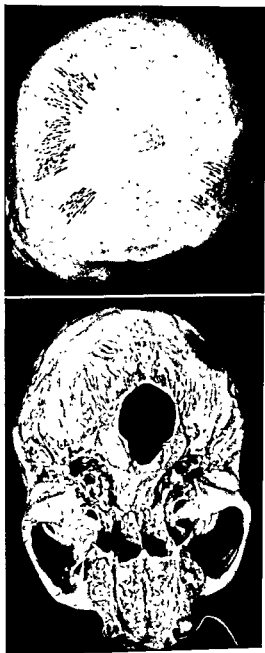


Fig. 9 Occipital blow in skull B with 14.3 inch pounds of energy. Sensitivity of lacquer at 0.00100. Extensive deformations are noted about the blow and at the base of the skull. This variation from skull to skull as concerns magnitude is seen frequently, but it should be noted that the distribution and direction of the patterns are essentially the same.

thickness and contour as well as by a slight change in the location of the blow from skull to skull. In one skull, "contrecoup" deformation resultant cracks in the lacquer were in the frontosphenoid region on

TABLE II.—VARIABLE ENERGY TESTS

Energy in pounds	Blows		
	Occipital	Posterior parietal	Frontal
8	C-8		
	D-8		
10	C-7	C-12	
	D-7	E-7	
	E-9		
12	G-9		
		F-9	
14.3		G-7*	
	B-2	C-2	C-3
	C-1	E-1	G-3
	D-1	F-1	B-3*
	E-2	G-1	D-3
16	G-2		
	C-9		
18	D-9		
		F-8	C-10
20	B-8	F-10	C-11
	E-10	E-8	G-8
24			C-13
			G-10

\*No cracks.  
Capital letters identify skulls and numerals following the letters signify test number.  
Note. Tests B-7 and F-7 (Table I) in locations other than above shown, hence not included in this table.

**Results with varying energies.** Energies varying from 8 to 24 inch pounds were used in the midfrontal, midoccipital, and lateral posterior parietal regions of the skull. In order to obtain more reliable information varying energies were used in different locations on the same skull. These procedures were carried out on three specimens, and comparison of results lead to similar conclusions. Whereas in the occipital region an absorbed energy of 8 inch pounds causes threshold deformations, in the midfrontal region 14 to 18 inch pounds of energy is necessary to obtain beginning cracks in the lacquer. Eight inch pounds caused no deformations of sufficient magnitude to crack the lacquer in lateral posterior parietal blows, but threshold deformations were obtained with the use of 10 inch pounds. The illustrations for this portion of the work are photographs of the same skull struck with blows of varying energy (skull C, Table I).

**Midfrontal blow with varying energies.** In all skulls energies of 10 and 12 inch pounds caused no cracks in the lacquer. With 14.3 inch pounds the

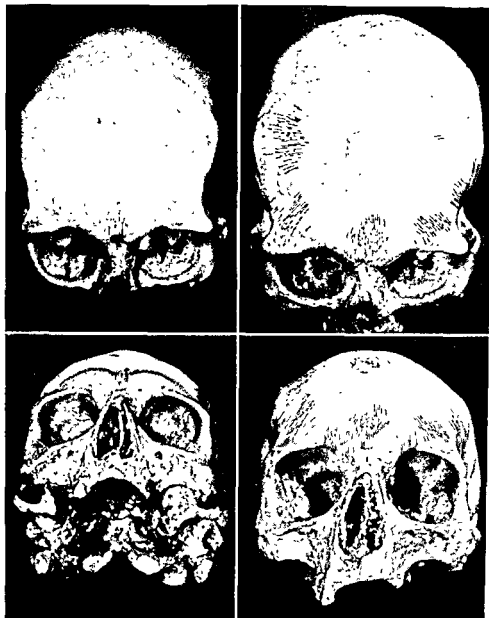


Fig. 10. A midfrontal blow in skull C with 20 inch pounds of energy (left upper and lower); with 24 inch pounds of energy (right upper and lower). Note the increasing intensity of deformation patterns with increase in the injuring energy. Sensitivity of lacquer 0.0005 in both experiments.

results are shown in Figure 2. In Figure 10 are shown photographs of deformation patterns following the use of 20 and 24 inch pounds of energy. In Figure 11 are seen the lateral views of these skulls. With 20 inch pounds of energy, only faint and minor deformations are noted. With 24 inch pounds, the cracks are more evident, heavier, and more numerous and comparable to those obtained in the midoccipital blow with 14.3 inch pounds of energy.

*Midoccipital blow with varying energies.* Patterns were obtained with as little as 8 inch pounds of energy (the sensitivity of the lacquer at 0.00095). With 10 inch pounds of energy the deformations

are more extensive. With 14.3 inch pounds of energy the deformations at the base are more numerous and there are some cracks in the lacquer covering the parieto-occipital region. With 16 inch pounds of energy, the cracks in the lacquer extend to the base of the middle fossa, to the petrous bones and the zygomatic arches. The cracks are heavier, longer, and more numerous (Figs. 12 and 13). In Figure 14 are shown contrecoup deformations of sufficient magnitude to cause cracks in the lacquer at the frontosphenoidotemporal junction. They were first seen with 10 inch pounds of energy and are more extensive with blows of 14.3 and 16 inch pounds.



Fig. 11. Lateral view of skull C in experiments described in Figure 10. The upper two photographs show the results of a blow to the midfrontal region with 20 inch pounds of energy and the lower two photographs are the findings following a blow with 24 inch pounds of energy. Sensitivity of lacquer 0.00105 in both experiments.

With 8 inch pounds no contrecoup cracks were noted.

*Lateral posterior parietal blow with varying energies.* Lateral posterior parietal blows with 10 inch pounds of energy caused a few faint lines of deformation in the parietotemporal region. With 14.3 inch pounds the deformations were much more extensive as shown in Figure 15.

#### EVALUATION OF STUDY

The human skull is well suited for study with the "stresscoat" technique. After convincing experimental data (3) it was concluded that deformation patterns in the dry skull are the same as in the living. The influence of scalp and muscles on the strain path is negligible. It should be emphasized that this method shows only tensile strain. Compression strain cannot be visualized. It should also be noted that behavior

the external surface of the skull has been studied thus far. Tensile strains of the internal surface are doubtless important following certain severe blows. Strain patterns may vary depending upon the location of the blow and small changes in location may produce altogether different paths of deformation. More work is needed to learn in greater detail the behavior of the skull to blows of varying location.

The strain paths depend upon the shape, contour, and thickness of the skull. Certain "chance" differences in skull thickness may produce profound differences in patterns. In our experiments, hammer and deceleration blows have been used. Actually, in automobile accidents and falls there be a combination of energies operating on the succession or simultaneously in more than one. Depending upon the velocity of the formation patterns may be given a certain

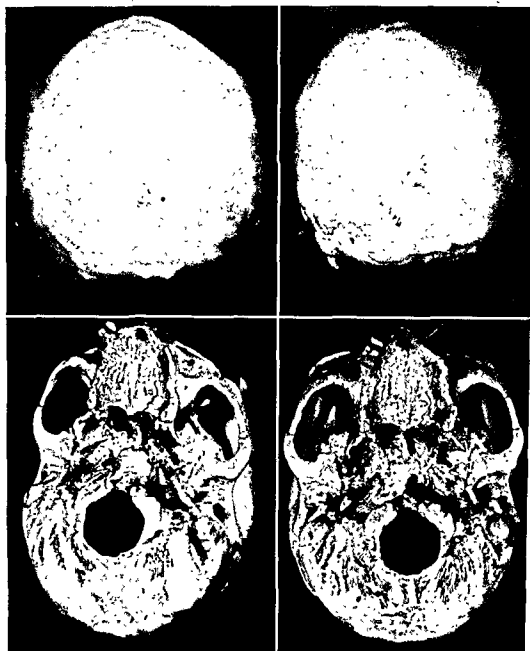


Fig. 12. Midoccipital blow with graduated energies on skull C. To the left, results with 8 inch pounds of energy and sensitivity of lacquer at 0.00105; to the right, results of a blow with 10 inch pounds of energy with sensitivity of lacquer at 0.00105.

directional quality. High velocity energies may cause localized deformation with comminution, depression, or perforation of bone. At the present time, we have no information concerning the behavior of a skull with energies of high velocity. In the present study velocities at the instant of impact varied between 5.4 and 9.9 feet per second.

In general, the paths of strain brought out by these studies parallel fracture lines seen clinically in the human. The deformation patterns are more common in the weaker than in the buttressed zones of the skull (4). Thus, very few cracks are seen in the lacquer extending longitudinally along

the median plane of the frontal and occipital bones. Relatively few deformation patterns are seen along the zygomaticofrontal and the petrosoparietal buttresses. Clinical data corroborate these findings. Fractures resulting from general deformations of the skull in general follow the strain paths seen in these experiments. With blows in the posterior parietal region, a fracture line extending down and forward toward the temple is commonly seen. Fracture lines in the occipital bone in general follow the strain paths seen in these tests. The three types of fracture seen include linear fractures extending into the



Fig. 13. To the left, an occipital blow with 14.3 inch pounds of energy and sensitivity of lacquer at 0.0005; to the right, an occipital blow with 16 inch pounds of energy and sensitivity of lacquer at 0.0005 inch per inch (skull C).

foramen magnum, linear fractures extending lateral to the foramen, and fractures which extend down toward one or the other of the large openings at the base of the skull such as the jugular foramen or the hypoglossal foramen. These may then extend forward toward the petrous bone. Fracture lines in frontal blows are usually seen extending toward the roof of the orbit in a paramedian position, much in the same direction as in the strain paths with midfrontal blows. It is obvious that with high velocity energies there may be localized deformation with comminution, depression or perforation. It has also been men-

tioned previously that depending upon the size, shape, and velocity of the injuring object, a certain direction may be given the strain paths.

Certain threshold values may be deduced from a study of Table II. Whereas in the occipital region 8 inch pounds of energy are sufficient to cause deformation patterns in the lacquer of the sensitivity used, in the midfrontal region 14 to 18 inch pounds of energy are needed for deformations of similar magnitude. In the parietotemporal region, threshold values are obtained with 10 inch pounds. It is therefore apparent that relatively minor blows may result in deformation

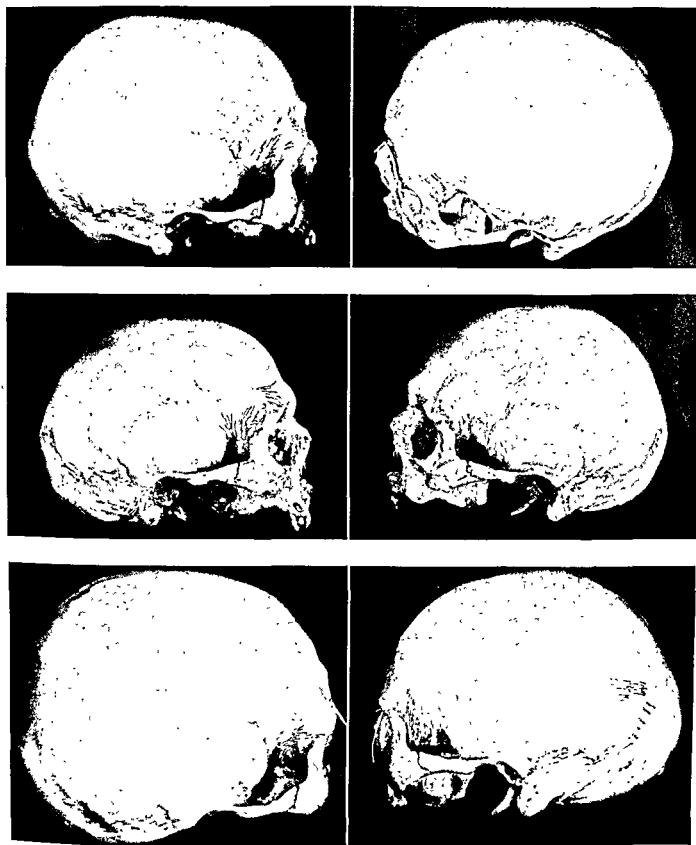


Fig. 14. Lateral view of skull C with midoccipital blow of 10 inch pounds of energy, 14.3 inch pounds of energy and 16 inch pounds of energy. Note that with 10 inch pounds (upper row) deformations are only slight; with 14.3 inch pounds they are more extensive (middle row), and they are most widespread with 16 inch pounds of energy (lower row). The deformation patterns are found at the frontosphenoidotemporal junction on one or both sides (contrecoup deformations).

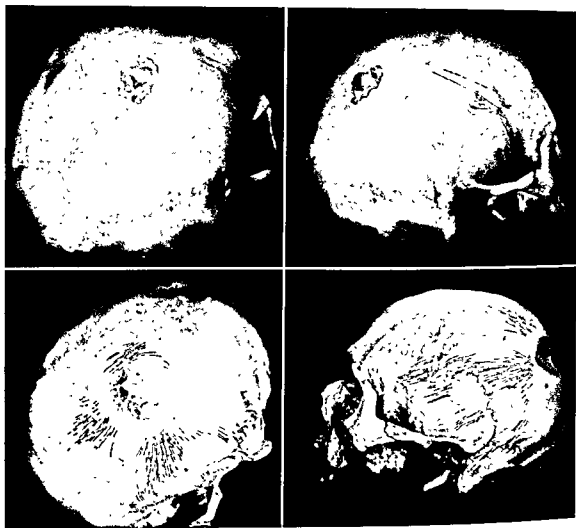


Fig. 15. Lateral posterior parietal blow in skull C with 10 inch pounds of energy (upper row), and 14.3 inch pounds of energy (lower row). The sensitivity of the lacquer 0.00095 and 0.00100, respectively.

of the skull with failure in certain regions. The case with which deformations are produced in the region of the foramen magnum and parieto-temporal regions may explain how in certain injuries linear fractures may obtain in these locations without loss of consciousness. A small amount of energy may be dissipated in causing deformation and failure of the skull. However, it may not be of sufficient magnitude also to result in adequate pressure waves in the cranial cavity to cause posttraumatic unconsciousness. A severe blow in the occipital region is associated with extensive deformation at the base of the skull thus helping to cause intracranial pressure waves to add to the serious intracranial injury. Whereas a weak blow may cause a symptomless fracture line, a severe blow may result in a serious state. It is clinically known that patients with

fracture of the base may be seriously ill and yet there are instances in which the symptomatology is very slight.

In one skull (C), occipital blows were consistently associated with deformation patterns at the frontosphenoidotemporal junction on one or both sides. From their position, they may well be called contrecoup deformations. Contrecoup fractures may thus be possible. Clinically, the association in some cases of "black eyes" with a fall resulting in an occipital blow may be explained by contrecoup deformations in the region of the origin of the temporalis muscles with postpalpebral bleeding.

#### SUMMARY

1. The amount of absorbed energy necessary to cause threshold deformations is different in vari-



ous parts of the skull. In the midfrontal region blows of 14 to 18 inch pounds of energy cause deformations of a magnitude similar to those obtained with 8 inch pounds in midoccipital blows.

2. A small amount of energy may be dissipated in deformation and failure (fracture) of the skull. However, it may not be of sufficient magnitude also to result in adequate pressure waves in the cranial cavity to cause posttraumatic unconsciousness. This may explain how in certain locations of the skull linear fracture may obtain without unconsciousness.

3. Contrecoup deformations of the fronto-sphenoidotemporal junction following midoccipital blows were obtained in one out of six skulls.

This argues in favor of contrecoup fractures in certain cases.

4. The distribution and direction of deformation patterns generally parallel fracture lines in clinical cases. However, the shape and velocity of the injuring object may influence and give strain paths a directional quality.

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# SPONTANEOUS RUPTURE OF THE ESOPHAGUS

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**S**PONTANEOUS rupture of a presumably normal esophagus has been reported only infrequently. The occurrence, therefore, of 3 cases in a period of 1 year in the experience of the senior author has prompted us to report these cases and review the literature.

The earliest case recorded is one by the Dutch physician Boerhaave, in 1724 (12). His brilliant description over 200 years ago of the onset and course of the disease and of the findings at autopsy leave relatively little to be added today. A few lines with regard to this report therefore are of interest:

Quoted from van Swieten: "We have a surprising observation given us by the celebrated Boerhaave which is, perhaps the only one published, namely, the illustrious Baron Wassenae, Lord High Admiral to the Republick, after intense straining in vomiting broke asunder the tube of the esophagus, near the diaphragm, so that after the most excruciating pains the aliments which he swallowed passed, together with the air, into the cavity of the thorax, and he expired in twenty four hours."

Quoted from Liebetaud: "From him (Boerhaave) it appears that the Admiral, who was more than fifty years old, suffered an annoyance at the pit of the stomach three days after feasting sumptuously. During the efforts to obtain relief by vomiting, the sudden pain, 'as from some rupture or tearing' occurred. During the progress of the affection he was constantly tortured with extreme pains. In the meantime increased suffering threatened syncope; there was neither fever, cough nor difficult breathing. The vehemence of the pains prevented any motion of the body and there was scarcely any remission from their great severity. They seemed to be seated primarily within the chest near the diaphragm, thence extended to the back and throughout the entire chest. Finally the strength gave way and he died suffocated, the horrid symptoms continuing. Nothing noteworthy was found in the abdomen; a large amount of gas escaped from the first incision into the pleural cavity. The lungs and heart were unaffected. A marked and unusual smell came from the chest, as if proceeding from some putrid fluid in which the posterior parts of both lungs were bathed; this fluid, amounting to six pounds, did not differ in the least from the con-

tents of the stomach. The body having been thoroughly cleansed, there was found a transverse rupture through the esophagus near the diaphragm."

The first review of this subject in the American literature was by Reginald Fitz of Boston in 1877 (12). He recorded a case of his own and described the disease at some length. The next comprehensive review appeared in 1914 (55). At that time Walker was able to find only 22 cases recorded in which rupture took place spontaneously in an esophagus otherwise normal. His case is the first of the 4 reported in the literature which have been diagnosed before death (1, 16, 50, 55). Since Walker's review several articles on this subject have appeared (1, 8, 16, 19, 32, 41, 50). Most have been solitary case reports. However, Gott in 1933 in a 10 year review of all admissions to the Louisville City Hospital was able to find 4 cases. Ridgway and Duncan in their review of 1937, believe that 3 of these cases are not representative of true spontaneous rupture. The latest review by Klein and Grossman in 1943 included only 40 cases gathered from the literature. We have been able to find only 1 case report since then (8). In contrast to rupture, perforation of the esophagus is not uncommon. It may follow the ingestion of a foreign body (3, 5, 18, 28, 30), instrumentation (21, 23, 25, 26, 53), external trauma (31) or erosion of a carcinoma, or result from a stricture (54) or syphilis (15). This is not the sort of injury under consideration, however.

Spontaneous rupture of the esophagus occurs at the lower end—usually within an inch or two of the cardia. At times the rupture extends down into the cardiac portion of the stomach. The posterior or posterolateral wall usually on the left side is the site most commonly involved. The rupture is usually a solitary one and in only 2 of Walker's 22 cases failed to be a longitudinal slit-like opening. The fissure may be one to several centimeters in length. Though in some cases there is evidence of pre-existing ulceration usually the mucosa and muscular coats are quite normal except for the immediate site of rupture.

Congenital weakness of the area seems unlikely as an explanation for the rupture. Twenty-five of the 35 cases reported by Ridgway and Duncan occurred during the third, fourth, and fifth decades of life. Menne and Moore could find only 3

TABLE I.—ACUTE CHOLECYSTITIS NEW YORK HOSPITAL—SEPTEMBER 1, 1932 TO SEPTEMBER 1, 1945

Total cases.....	527
Deaths.....	13
Mortality, per cent.....	2.46
Operative Procedures	
Cholecystectomy.....	460
Cholecystostomy.....	67*
Common duct exploration.....	43

\*12.6% of total operations.

additional procedure of exploration of the common duct was limited to those in which indications were definite, and these totaled 47, or 8.9 per cent. The policy has been adhered to that the welfare of the patient is continually to be kept in mind and that the operative procedure employed is to be that which promises the greatest possible benefit and least hazard. The operation is not decided upon entirely before the procedure is undertaken. For instance, if during operation cholecystostomy seems to be the procedure of choice, cholecystectomy is abandoned.

Cholecystostomy was performed in 67 instances and was followed by 5 deaths. This procedure is clearly indicated when the patient is too ill to withstand cholecystectomy or when cholecystectomy presents too great difficulties. For the extremely debilitated patient or for the very ill, we doubt if there are any contraindications for cholecystostomy. It may be done under local anesthesia, disturbing the patient very little; and it may be a life-saving operation. The decompression of the biliary tract averts catastrophe by preventing progressive liver damage if complete biliary obstruction is present.

In determining the type of operation to be done, the gross appearance of the presenting pathological changes is of importance. In the first place, if there is gangrene and perforation with accompanying generalized peritonitis, simple drainage of the abdomen together with cholecystostomy is indicated. If there is gangrene and perforation which has resulted in localized peritonitis or abscess in the region of the extrahepatic portion of the gall bladder, then one may choose between cholecystectomy and cholecystostomy. However, in the presence of extensive adhesions of the omentum to the gall bladder and into the

TABLE II.—ACUTE CHOLECYSTITIS, NEW YORK HOSPITAL, SEPTEMBER 1, 1932 TO SEPTEMBER 1, 1945—PATIENTS FIFTY YEARS OF AGE OR OVER

Total.....	175
Deaths.....	9
Mortality, per cent.....	5.4
Operative Procedures	
Cholecystectomy.....	140
Cholecystostomy.....	35*
Common duct exploration.....	22

\*20% of total operation.

biliary fossa, it is indeed questionable whether these should be disturbed and a cholecystectomy done. If the patient is unusually ill and if postoperative complications appear in the offing, then certainly cholecystectomy should not be attempted. Perforation of the gall bladder with a small abscess or perforation into the adjacent liver tissue is no contraindication to cholecystectomy. The patients with simple acute cholecystitis are in general best treated by cholecystectomy.

Common duct exploration in acute cholecystitis has been limited in our clinic to those patients with unequivocal indications for common duct obstruction. If these exist, common duct exploration should be undertaken even though it adds additional risk to the procedure. The incidence of postoperative complications is in this series apparently increased. At the same time it may be said that these patients are usually in the group that is more seriously ill. For the extremely ill, jaundiced patients, decompression (that is, cholecystostomy) may be utilized as a compromise procedure, having in mind, of course, following the subsidence of jaundice, the exploration of the common duct with the patient in a greatly improved condition.

The presence of jaundice requires the determination of blood prothrombin and the evaluation of any bleeding tendency, and, in the presence of acute disease, time may not be afforded for this. For such patients the use of whole blood transfusions and parenteral administration of vitamin K may prevent serious postoperative hemorrhage.

The common duct was explored in 47 of the patients in this series, an incidence of 8.9 per cent. Stones were recovered in 29 of these, or 61.7 per cent. It is probable that the opening

cases in childhood—a time when congenital abnormalities are likely to become manifest and when vomiting is especially prone to occur. Also the reported cases usually do not present thinning of the muscular coats.

Ulcerative esophagitis and peptic ulcer of the esophagus are entities which are now recognized and perforation and hemorrhage can occur in these ulcers (4, 13, 27, 38). It is questionable whether such cases should be included in a consideration of spontaneous rupture of the esophagus. The possibility of an acute linear peptic ulceration in the remaining cases still is present. Moreover the factor of peptic digestion of a traumatic fissure is even more difficult to rule out. Two cases have been reported of rupture of the esophagus after extensive burns (49, 51). In 1 Curling's ulcers were present also in stomach and duodenum (51).

There seems little question that the most important factor in spontaneous rupture of the esophagus is that of sudden increase in pressure. Cases have been recorded following crushing injuries of the abdomen, (1, 41) during convulsive seizures (32), and during defecation (42). In 23 of the 35 cases reported by Ridgway and Duncan vomiting had preceded the rupture. Of the 25 in whom an accurate history could be obtained, 18 were alcoholics. Though the alcohol in itself may have a deleterious effect on the esophagus, it seems likely that the nausea, retching, and vomiting associated with excessive drinking are the more important factors in rupture.

In 1884 (8) McKenzie demonstrated experimentally that the lower end of the esophagus is the weakest portion. Weiss and Mallory (37, 56) were able experimentally to reproduce linear fissures of the lower end of the esophagus and cardia by increased pressure.

Weiss postulated the following (20): Vomiting is a complicated and highly co-ordinated mechanism. The pylorus closes and the cardia and esophagus dilate. A wave of counter peristalsis is set up, and the esophagus relaxes. A sudden convulsive rise in intra-abdominal and intragastric pressure empties the stomach. If vomiting is repeated the vomiting center becomes fatigued. Co-ordination is lost and the esophagus and diaphragm fail to relax in the face of the sudden increase in pressure, resulting in rupture. The fact that at least 2 cases (12, 54) occurred during strenuous vomiting in attempts to dislodge a bolus of food in the esophagus would lend support to this theory. Rupture has been reported in association with neurogenic disturbances but this is certainly uncommon and an unimportant and irrelevant factor in this presentation (9, 39).

In only 5 of the 35 cases reported by Ridgway and Duncan were the patients females. The significance of this is not certain unless the picture of alcoholism is considered predominant in the male.

Rupture of the esophagus usually takes place during an episode of vomiting, often precipitated by a bout of drinking or a heavy meal. The patient experiences sudden severe pain high in the upper abdomen or epigastrium or beneath the sternum. Frequently the pain radiates to the back or to the interscapular region—the left side being more often the site of reference than the right. With the onset of the pain, some have felt a sensation of something tearing or giving way in the chest. If vomiting is repeated the vomitus is likely to be bloody. Though the pain is usually severe and persistent and often is not relieved significantly by morphine, in some cases the pain has not been severe but has been more in the nature of a pressure or discomfort in the region of the rupture. Food particles are often found in the posterior mediastinum. Rupture into the pleural cavity (usually the left) is not uncommon. If this be true gastric contents may be found here also. Even though the pleural cavity is not actually invaded, pleural effusion is often present because of the adjacent mediastinal irritation. Though hemorrhage may be rather profuse after rupture the real threat to the patient is that of a fulminating mediastinitis and death. There has been no case reported so far in the literature in which recovery has taken place, though in an editorial footnote in the 1944 *Yearbook of Surgery*, Graham mentions 2 cases which resulted in empyema and recovery following drainage of the empyema. This same course has been reported following perforation of the esophagus.

On examination the patient is found to be obviously critically ill. Shock is profound. Thirst is extreme and the patient may be able to take fluids by mouth with little difficulty or discomfort, though some discomfort may be felt locally at the site of rupture as the material swallowed passes over it. The blood pressure is low, the body temperature may be depressed and the pulse is rapid. The skin is cold and clammy; there is a pallor which quickly gives way to marked cyanosis. Dyspnea is often present and the respiratory rate is increased.

Initially findings on examination of the chest may be normal, and the upper abdomen is somewhat tender and guarded. However, as time passes the abdominal signs tend to diminish and the chest signs become more prominent with the development of rales and dullness at the lung bases. Some have been able to detect an abnormal

sound of fluid and air in auscultation of the chest during the swallowing of water. In about half the cases subcutaneous emphysema eventually develops. It is manifested first in the suprascapular fossae and the suprasternal notch but later extends to involve the entire neck, face, trunk, and even the extremities. Wangenstein once said: "In the drowsy small hours of the night, I have once made the diagnosis of spontaneous perforation of the lower esophagus over the telephone in conversation with the surgical resident on the basis of subcutaneous emphysema in a patient who had upper abdominal pain, no dyspnea, or cough." (45). If rupture extends into the pleural cavity physical signs of hydropneumothorax develop and gastric contents may be aspirated from the chest. Three cases diagnosed before death were discovered in this way (1, 16, 50). X-ray examination usually shows mediastinal emphysema within a few minutes of the time of rupture, long before the air becomes evident in the subcutaneous tissues of the neck. A fluid level in the mediastinum may also be demonstrated by x-ray examination.

The differential diagnosis includes coronary occlusion, dissecting aneurysm of the aorta, pulmonary embolism, spontaneous pneumothorax, ruptured peptic ulcer, acute pancreatitis, and mesenteric occlusion. The abdominal pain is so prominent a feature that many have been subjected to exploratory laparotomy (1, 24, 52, 55).

#### CASE REPORTS

**CASE 1.** L. B. H. This 55 year old white man, was admitted September 18, 1944. He was a known alcoholic for many years and had recently been on a prolonged spree. The day of onset of his illness he did not feel well but had no particular complaints until 6:00 p.m. when he suddenly vomited before dinner. Some blood was seen in the vomitus. There was some upper abdominal pain and substernal distress but no rigidity of the abdomen and little tenderness. His pain increased and the upper abdomen became rigid. In addition a tightness of the lower chest was noted. The diagnosis of ruptured gastric or duodenal ulcer or acute pancreatitis was considered so he was explored 6 hours after the onset of his trouble. Nothing was found. He continued to vomit bloody material and gastric suction drainage was instituted. In spite of supportive treatment he failed to do well and showed marked circulatory collapse. The senior author was called in consultation the following morning. At this time subcutaneous emphysema was found on both sides of the neck. A chest film showed air in the mediastinum. An electrocardiographic tracing was normal. The serum amylase was 75. A diagnosis of rupture of the esophagus was made. The patient was *in extremis* at the time, however, and nothing could be done. He died at 6:00 p.m. that night, 24 hours after the onset of his illness.

At autopsy there was found a longitudinal rent 2 centimeters in length at the lower end of the esophagus. The surrounding mediastinal tissues up to the bifurcation of the trachea were inflamed, discolored, and necrotic. The right pleural cavity contained 450 cubic centimeters of clear

amber fluid and the left 600 cubic centimeters with much admixture of blood on this side. The mediastinal borders of both lungs adjacent to the area of rupture showed fibrinous exudate. The stomach and duodenum were normal. However, blood was present in the intestinal tract.

**CASE 2.** No. 42030. This 76 year old white man was admitted to the Hospital of the University of Pennsylvania on October 16, 1944, on the service of Dr. Edward Rose and Dr. William H. Erb. In 1939 a resection of the sigmoid was carried out because of a nonspecific infectious granuloma. A fecal fistula had persisted following the resection. For a few days prior to the present admission he had suffered some nausea. At 10:00 a.m. on the day of admission he had a sudden onset of vomiting. A second bout of vomiting contained blood. In a few minutes excruciating pain in the left lower chest and back developed which could not be relieved by morphine. The chest was clear on admission. His white blood count was 16,000. A survey film of the abdomen showed only large bowel distention. A chest film was negative. The electrocardiographic tracing was equivocal. He went into profound circulatory collapse and died 19 hours after the onset of his illness.

The clinical diagnoses included: coronary occlusion, dissecting aneurysm, and mesenteric thrombosis. Rupture of the esophagus was also considered when the senior author was called in consultation since Case 1 had been seen by him only the month before.

At autopsy the right pleural cavity was free of fluid. The left side contained air under pressure and 1500 cubic centimeters of brownish red fluid with clots. There was rupture of the mediastinal pleura in the region of the esophageal hiatus, and the lung was collapsed. A longitudinal rupture of the esophagus was found, 3 centimeters in length at the esophagogastric junction with no evidence of pre-existing ulceration. Two benign prepyloric ulcers were found in the stomach.

**CASE 3.** E. Y., No. 65235. This 44 year old white woman was admitted on August 25, 1945, to the senior author's service at the Hospital of the University of Pennsylvania with a history of abdominal pain of 30 hours' duration, requiring morphine for relief. Though there had been some nausea and vomiting these were not prominent features in the history. On examination she was found to have a tender mass in the left lower quadrant, also felt on pelvic examination. A diagnosis of strangulation was made and exploration was carried out the day of admission. A gangrenous loop of ileum was found. Resection and primary anastomosis were performed. She did very well for 24 hours after operation. Her abdomen was soft and flat and peristalsis was present. Suddenly she developed a heavy substernal pressure with palpitation and generalized weakness and a sensation of smothering. She was pale and had a marked tachycardia. A medical consultation was obtained and an electrocardiographic tracing was done. Coronary occlusion could not be ruled out, but the consultant felt that pulmonary embolism was a more likely diagnosis. She was given morphine, oxygen, and plasma and seemed to rally for a time. Ten hours later, however, she again developed substernal distress, palpitation, and weakness. She went into increasingly profound peripheral circulatory collapse with intense cyanosis and cold clammy extremities. The pulse became imperceptible and the blood pressure unobtainable. A second electrocardiographic tracing was not made and no changes could be found in it which were not consistent with profound circulatory failure. A Levine tube had been placed in the stomach following operation. The tube was removed at this time (35 hours after operation) because of respiratory distress. Repeated vomiting of coffee ground material followed removal of the tube, but it was not replaced because of fear of trauma to the bleeding site.

She failed to respond to treatment for shock and died, 30 hours after her first attack of substernal distress and 54 hours after operation.

At autopsy there was found a rupture of the anterior wall of the esophagus at the distal end. The rent was about 1.5 centimeters in diameter. The surrounding wall showed thinning of the muscularis. The adjacent mediastinal tissues were deeply stained with partially digested blood. The pleural cavities contained small amounts of straw colored fluid.

The possible rôle which the Levine tube may have played in this case is uncertain. Constant gastric suction drainage is now often used for periods of much longer than 24 hours with no difficulty at all. Of passing interest was the discovery at autopsy of an adenoma the size of a walnut in the cortex of the right adrenal (unsuspected).

Spontaneous rupture of the esophagus is no doubt much more common than appreciated. Many of the deaths in the past must have been erroneously attributed to the factors listed in the differential diagnosis. Postmortem examination is necessary to rule out the disease and has been the sole method of diagnosis in most of the cases reported. An autopsy, unless carefully conducted, may overlook the lesion. If the esophagus is divided just above the cardia and not removed *en bloc* with the stomach, the pathologic picture may be missed or destroyed.

Ninety per cent of perforations of the esophagus occur in the cervical region (22). For a long time the anatomy of the neck (7, 11, 33) and the methods of spread of infection in it (43, 45, 47) have been well understood. Many cases of perforation in this area have recovered following prompt anterior cervical mediastinotomy, even without the aid of chemotherapy (2, 6, 22, 29, 44, 46). This approach is of value for perforation or infection only above the level of the fourth or fifth dorsal vertebra—a level well above the area of the mediastinum involved in spontaneous rupture of the esophagus.

Posterior mediastinotomy was first described on the cadaver by Nassilow in 1888 (14). In 1898 Cavazoni drained an abscess in the posterior mediastinum by the dorsal approach with recovery of the patient (14). The approach is now well understood and many patients have since been drained in this way with recovery (34, 35, 36). These have all been cases of a perforation recognized immediately or of a localized abscess. With the agents now available the question rises as to whether chemotherapy alone can replace operation in rupture or perforation of the esophagus as in the case reported by Heatly. It seems likely that extensive rupture with gross contamination of the mediastinum will still require drainage.

The mortality reported so far in spontaneous rupture of the esophagus is 100 per cent excluding the 2 cases mentioned by Graham. Most patients succumb within 24 hours though 1 patient survived 17 days (16). With improved techniques in anesthesia, freer use of blood and plasma for intravenous infusion, and effective chemotherapeutic agents, the limiting factor in the treatment of this condition is that of diagnosis. It does not seem at all unlikely that soon recoveries from this condition will be reported. Prompt resort to the use of roentgenography and esophagoscopy in questionable cases should enable one to establish the diagnosis early. Just as in perforation of the cervical esophagus, prompt operation leads to a low mortality (45) so prompt recognition of spontaneous rupture of the esophagus will be necessary if recoveries are to be obtained.

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the ducts and acini of breasts belong most likely in the same category.

It is noteworthy in reviewing the voluminous literature on the relationship of chronic cystic mastitis to cancer that opinions vary from nil to 20 per cent, which again brings to one's realization a bewildering conflict of opinions. Bloodgood, who had been a contemporary advocate of the casual relationship of chronic mastitis to cancer of the breast, had a change of mind after a more profound study of the subject. He was the first really to challenge, in 2 masterful papers, the concept that had prevailed for many years. In the first in 1921, he reported 128 cases in 3 of which cancer developed; in the second in 1929, he reported 500 cases in only 5 of which cancer developed, an incidence even less than occurs in the absence of cystic disease. His studies are of particular value since they combined and correlated the microscopic picture with the clinical course of the disease in some instances for 29 years.

Bloodgood submitted sections of every type of chronic cystic mastitis to more than 40 consulting pathologists. In the majority of cases there was disagreement. The percentage of those favoring benignancy varied from 20 to 90; furthermore, in tissues and sections that were sent to him for diagnosis he had never received one which proved to be a fully developed cancer that had not been diagnosed cancer, whereas he had received many with the diagnosis of cancer which in his opinion belonged to some form of chronic cystic mastitis, further illustrating the difficulties of the histologic interpretation of the nature of growth—or overgrowth. He concluded by saying that in breast lesions when good pathologists disagree as to malignancy, the patient lives. When there is agreement there is always a large percentage of deaths from cancer.

Reclus, an outstanding student of the subject, in 1883, 38 years before Bloodgood's challenge, also had a change of mind. While he originally believed in the benignancy of cystic disease, he had been influenced by the pathologist to question his stand only to revert to his original opinion after further study of his cases upon learning that those that had been treated conservatively remained well.

In 1934 Campbell summarized the literature and contributed a series of 290 case studies of cystic disease with clinical follow-ups from which he was compelled to conclude that cystic disease is not a precancerous lesion; that malignant changes are no more likely to follow this disease than to occur in breasts that are entirely free from this condition. He includes in this study the

adenocystic (Schimmelbusch's disease) variety. Two patients of the 290 cases reported developed breast cancer—0.7 per cent. He contends that the clinical test of time is the true answer to the controversy.

Lewis and Geschickter in 1938 reported 515 cases of cystic disease. Two hundred fifty of this number were followed for more than 5 years. One of this group of 250 died of breast cancer, an incident of 0.4 per cent. From this study it is their conviction that cystic disease is not a precancerous lesion.

Warren in 1940 presented a comprehensive study in which he concluded that 4.5 times as many cases of chronic cystic mastitis subsequently developed cancer of the breast, age for age, as would be expected for the female population as a whole. His studies include all forms of mastitis. He does agree, however, that the large, clinically palpable cysts with atrophy of their lining epithelium are less likely to be followed by cancer than are those with active, often papillary, epithelium and that aspiration of the contents may be a justifiable therapeutic procedure. However, he believes excision to be preferable since it is difficult to determine the exact nature of cell hyperplasia if present.

Thus it is evident that whether hyperplastic cystic disease (large simple cysts, papillary cysts, papillary cystadenomas and duct adenomas) is endowed with malignant qualities or not is a question still not settled. It is however, fair to state that all students of the subject agree that the larger (clinical) cysts are relatively harmless. There are those who believe that they are entirely harmless. Yet in recent times no one seems to have the conviction or courage to treat these large simple cysts by puncture.

For reasons already stated, to remove a large cyst, in which there is little or no hyperplasia of the cells of the walls, while leaving innumerable smaller cysts, also acini and ducts with definite hyperplasia of cells, is inconsistent and unsound reasoning. And to repeat also, that which cannot be felt or seen (still) causes no concern.

That these simple cysts are harmless, in so far as being forerunners of malignancy is concerned, became my conviction 14 years ago. Since that time I have managed simple cysts by puncture as a diagnostic and therapeutic office procedure.

In making the clinical examination the experienced observer can in a goodly number of cases be correct in his conjecture as to the nature of the lump he is dealing with but this conjecture must be verified. A cyst of clinical size if superficially located transmits, as a rule, to the exam-

ining hand, the feel of just what it is—a cyst that is tense but not hard as is a fibroadenoma. While movable, it does not “shuck” around like a fibroadenoma or a lipoma (rare). The deeper lying cyst often imbedded in dense and thickened connective tissue stroma cannot be differentiated by the feel from malignant growths. In either case there is no skin attachment.

The following is the office procedure for diagnosis. In the absence of clinical signs of malignancy the overlying skin is injected with local anesthetic by means of a fine needle; a larger needle is then introduced into the lump. If it is a cyst the plunger of the syringe will be pushed up by the fluid under tension. Pressure with the fingers over the lump area helps to remove the last drop of fluid, so to speak. Few cysts so managed refill. It has been conjectured that it is because of complete emptying that so few refill. From my experience I have learned to form an opinion on the nature of a lump, that is not a cyst. A fibroadenoma is tough like rubber; a thickened wall of a deep seated cyst is likewise rubbery; a medullary carcinoma is soft, as is a lipoma; a scirrhous carcinoma transmits a gritty feel. While this interpretation of “feel” has no special practical value it is a refinement in clinical diagnosis and gives some satisfaction when committing oneself to a definite preoperative diagnosis.

This report of 57 case studies is limited to clinically palpable, large simple cysts exclusive of other forms of cystic mastitis. While the number of cases is not large, its importance lies in the period of observation; namely, 14 years. All have been followed and checked to the present time.

*Age incidence.* The peak of incidence was in the latter half of the fourth decade. The youngest subject was 27 years of age; the oldest 62 years. In the 26 to 30 year age group there was 1 case; in the 31 to 35 year group, 5 cases; in the 36 to 40 year group, 13 cases; in the 41 to 45 year group, 13 cases; in the 46 to 50 year group, 2 cases; in the 51 to 60 year group, no cases; in the 61 to 65 year group, 1 case.

*Child bearing.* Twenty-six of the 57 patients had borne children; 30 were childless; in 1 patient, not recorded.

*Number of cysts.* The 57 patients had a total of 123 discernible cysts; 15 patients had cysts in both breasts. Thirty-three had 1 cyst, 12 had 2 cysts, 2 had 3 cysts, 4 had 4 cysts, 4 had 6 cysts, 1 had 9 cysts, 1 had 11 cysts.

*Incidence in right or left breast.* The left breast harbored slightly over twice as many as the right; left breast, 29 cases; right breast, 13 cases. In 1

of these patients an early carcinoma was present in the opposite breast. Both breasts were involved in 15 patients.

*Location.* The upper hemisphere, especially the upper outer quadrant, is more often affected than the lower in the ratio of 3 to 1.

*Size.* The size of the lumps varied from a hazelnut to a tennis ball; the average from a hazelnut to a walnut. The amount of fluid varied from  $\frac{1}{2}$  to 45 cubic centimeters, the average from  $\frac{1}{2}$  to 10 cubic centimeters.

*Character of contents.* Cloudy, grayish with a greenish cast is the usual appearance of the contents; less frequently it has a brownish cast. In 2 cases, the cysts were blood containing; one was excised. The other patient, one of the earlier cases, procrastinated but no trouble followed.

*Dry puncture.* In 2 cases, deep seated lumps proved on excision to be cysts embedded in dense heavy connective tissue stroma. The needle had gone past the cysts which were small—the size of a hazelnut.

*Mastectomy.* In 2 cases, multiple large cysts in both breasts embedded in heavy dense stroma, kept on refilling and were painful; these were finally treated by mastectomy. In only 3 other cases, as far as could be ascertained, was there refilling.

*Simple cyst and early malignancy.* One patient had a cyst in one breast; a small lump in the other that gave a dry tap proved upon excision to be an early carcinoma and was treated accordingly. There was no histologic evidence that the malignant lesion had its origin in mastitis of any form. This was the only malignant growth encountered in the series of 57 cases.

The 57 patients were spared 83 surgical operations in all, since in several cases cysts appeared subsequently.

#### DISCUSSION

The report of this series of cases may not be sufficiently convincing to settle an old argument. However, study of clinical cases followed through for as long as 14 years, average  $7\frac{1}{2}$  years, is strong evidence. The behavior of growth is, in the last analysis, the answer to its nature. It should be more convincing than the evidence of microscopic interpretation of growth which, admittedly, is not infrequently difficult and erroneous.

The nature of every lump in the breast must be determined. (One case of a cyst in one breast; an early carcinoma in the other).

It is said that simple cyst lumps cannot with real certainty be differentiated from cancer by palpation. The answer to that is needle puncture—most simple, an office procedure. It gives identi-

cal information and the same protection to the patient that is obtained by excision. It is equivalent to the discovery by the surgeon that the lump excised is a cyst, whereupon also the surgeon carries the operative procedure no further. In the event of multiple cysts or others to appear, it becomes then a piecemeal, unsatisfying job of surgery. Such instances come to one's attention not infrequently. All in all, in that case, it means the hard and costly way for the patient.

In the 57 cases comprising this study, there was one instance of early malignancy in one breast; a simple cyst in the opposite one, in a patient 50 years of age—an incidence of 1.7 per cent; normal incidence said to be approximately 2 per cent.

The fact that whereas chronic cystic mastitis is one of the commonest lesions found in the female breast, yet cancer of the breast occurs in relatively only a small percentage (approximately 2 per cent) of individuals, is in itself strong evidence to absolve chronic cystic mastitis from being a forerunner of breast carcinoma.

The more recent exponents of the benignancy of simple cysts of the breasts notably Bloodgood,

Campbell, Lewis and Geschickter still advocate excision for the most part. The author's experience is in agreement as to the benignancy of simple cysts but he differs only in the management of them, in that he has practiced simple puncture consistently for the past 14 years as a diagnostic and therapeutic office procedure. The patient is thereby afforded protection equal to that of excision. At the same time it has spared her the ordeal of an operation—or even operations, with all it entails—not excluding hospital cost and surgeon's fees.

NOTE.—Anyone not trained, skilled, and experienced to do radical breast surgery should do neither a simple puncture nor a biopsy.

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# SURGICAL ASPECTS OF TRENCH FOOT

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ON February 7, 1945, this former Army Service Forces Convalescent Hospital was designated a general hospital, largely for the treatment of trench foot and frostbite injuries. In addition, a portion of the camp facility has been rebuilt to function separately as a convalescent hospital, and the two institutions, grouped together, comprise a hospital center for the study, treatment, rehabilitation, and disposition of trench foot cases. During the 4 months between February 7, 1945, and June 7, 1945, 4,892 soldiers with frostbite and trench foot were admitted to this hospital center. Many were litter cases on arrival; more, however, were ambulant. Originally, all were assigned to the medical service. There, the great majority became not only ambulant, but reached a maximum degree of hospital benefit; 264 had varying degrees of persistent gangrene, and it was a policy of this medical department to transfer these cases to surgery after they had attained maximum improvement on the medical regimen. The time involved in gaining this improvement varied from 4 weeks to 2 months.

At this point, the current concept of trench foot might be briefly mentioned because it is upon it that the rationale of treatment is based. Main factors concerned in the development of this injury apparently are the following: (a) Exposure to cold but not necessarily freezing weather for (b) varying lengths of time from a few hours to, usually, several days, and occasionally much longer periods, during which (c) the feet are wet or at least damp, and, in addition, are (d) constricted by foot gear that is not too tight for ordinary wear but is too tight for feet beginning to swell, and finally, but not the least factor in importance, (e) prolonged relative immobilization of the whole body, particularly the dependent legs and feet. This prolonged exposure, in which tight shoes and wet socks enclose cold and immobile feet, brings about trench foot. Perhaps, in some

cases, all these factors need not be present to bring it on, but if all are present, its development is quite likely. Relative malnutrition and fatigue may occasionally be additional factors.

Early, it is known, there occurs reflex capillary and arteriolar vasoconstriction. Anoxemia of all tissues of the toes and foot follows for this reason, and also because of lessened oxyhemoglobin dissociation which occurs at low temperatures. Anoxemia leads to damage to all affected tissues. At this stage, the feet are insensitive but hours later, on removing the feet from the faulty environment, a contrasting reaction occurs. Feet and toes become red and hot to palpation, and burning hot subjectively. They swell and the toes become dusky. Hemorrhagic blebs may appear on both soles and dorsum of feet and toes. At this early stage it is believed the capillaries are dilated, their endothelium damaged and the capillary stream slowed. Increased capillary permeability leads to increased exudation into interstitial and intercellular spaces of the foot. So much fluid escapes that the edema may appear in the epidermis as blebs. The anoxemia, already aggravated by edema, is further increased by thrombosis of many small arterioles, consequent upon their damaged endothelium and vascular stasis. If during this stage the foot be heated or exercised as a therapeutic measure, all these unfavorable factors become aggravated. Local nerve tissue also suffers from anoxemia. Due either to irritation or destruction of peripheral nerve elements, vasomotor changes follow, also sensory and, presumably, trophic changes as well. All other structures also suffer. As the edema subsides, an inflammatory type of repair occurs in the viable areas above the demarcation line. The end-result is fibrosis, not only of the subcutaneous tissue where fat has been lost, but of intrinsic foot musculature as well. Tendon sheaths become involved in adhesions. Joint capsules acquire adhesions and frequently there results a chronic noninfectious arthritis and synovitis. Periosteum may thicken and bone cortex becomes decalcified. Marrow may become replaced by fibrous tissue. Toe nails exhibit evidence of an arrest in growth. A transverse raised ridge may later be seen growing out of the nail bed and for many months the nail is thickened and deformed. Typically a mixed type infection exists at the demarcation

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The following additional officers participated in the surgical care of these cases and contributed to the opinions and evolution of surgical principles outlined in this paper: V. L. Hart, Lieutenant Colonel, M.C.; Seventh Service Command orthopedic consultant; Harry W. Woodward, Lieutenant Colonel, M.C.; Harold L. Gordon, Major, M.C.; Jesse F. Harrold, Major, M.C.; Norbert J. Kulzer, Captain, M.C.; Alvin R. Megahan, Major, M.C.; Gordon S. Owen, Captain, M.C.

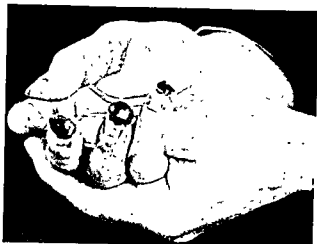


Fig. 1 Photograph of gangrene of finger tips resulting from frostbite.

line, but this does not often spread far into nearby viable tissues. The distal part remains black, dry and leathery. Less severe cases have only gangrene of the skin, the deeper structures remaining viable. Such toes cast off their dead shell after new skin has regenerated beneath it.

In contrast to these severe cases, the greater number do not eventuate in gangrene at all. Although most feet become anatomically normal after several weeks or months, many continue painful on weight bearing and sensitive to cold for an indefinite period. This report is not concerned with these lesser degrees of trench foot, which were not under our direct observation.

Most surgical cases had only distal parts of some toes devitalized and consequently required partial toe amputations. A small number lost all toes on at least one foot, and some lost one or more metatarsal heads as well (Table I). In a few cases, and these were usually severe ones (Figs. 1 and 2), trench foot was associated with leg wounds, such as a compound fracture or trauma to the femoral artery. In these circumstances, the soldiers had been lying on cold ground, from several hours to as long as 3 days.

**Preoperative routine.** The patients were given every chance to improve on conservative manage-



Fig. 2. Trench foot gangrene of distal portion of foot associated with compound comminuted fracture of femur.

ment. Active and passive exercises were given to the toes, many of which were atrophic and fixed in partial flexion. The patients were instructed as a group forcefully to flex and extend their toes—using their fingers to do it. This ward exercise, done several times daily, was combined with a lanolin lubricated massage to relieve the dry scaling frequently seen on these toes. Adequate passive and active motions tended to free adhesions about tendon sheaths and joint capsules, and many toes that would otherwise have had to be amputated before shoes could be worn, were thereby saved. In addition to exercises to loosen up fibrotic toes, active foot and ankle exercises were employed to prevent contracture of the tendo achillis and gastrocnemius soleus muscle group with consequent talipes equinus and pes cavus. Other frequently employed types of physical therapy, and whirlpool baths, in particular, have proved of no use in most cases.

The usual preoperative laboratory work included smears and cultures taken at the demarcation line. Not only was the bacteriological flora identified but, if applicable, penicillin sensitivity tests were reported at the same time. This entailed only an additional day's delay in receiving the report. Of 95 cases in which penicillin sensitivity composed part of the bacteriological study,

TABLE I.—DISTRIBUTION OF GANGRENE

	Cases
Partial gangrene of toes	197
Loss of all toes of a foot at proximal joint	11
Loss of one or more metatarsal heads	32
Loss of all metatarsal heads	35
Loss requiring transfer to center for "below knee" amputation	2
Gangrene with loss of heel plantar skin	6
Gangrene of fingers (Fig. 1) . . . .	3

TABLE II.—BACTERIOLOGICAL FLORA

	Cases
Resistant to 1 unit penicillin per c c	23
Hemolytic <i>Staphylococcus aureus</i>	7
<i>Bacillus coli</i> . . . .	
Susceptible to 1 unit penicillin per c c	15
Nonhemolytic corneobacterium	9
Hemolytic diphtheroid corneobacterium	10
Beta hemolytic streptococcus	





Fig. 3. Left, This great toe had formerly been black up to the metatarsophalangeal joint. The gangrene was only superficial and was cast off like a glove. (Note the transverse ridge on the nail.)

Fig. 4. Thin grafted skin is unsatisfactory permanent covering for end stumps. It ulcerates when weight bearing is attempted.

it was found that most wounds harbored at least 2, and often 3 or 4 organisms. Table II shows the spread of the flora.

The trench foot cases were routinely given a preoperative injection of 50,000 units of penicillin intramuscularly when they received preoperative medication. The routine use of sulfa drugs was not encouraged because of the needlessly increased risk of reactions associated with their use.

Roentgenograms of the involved foot were requested as part of the preoperative work.

*Surgical principles.* Since no clear cut precedent had established all the surgical principles concerned in the surgical treatment of trench foot, the general plan of treatment underwent evolution as experience accumulated. For instance, it was deemed wise to delay surgery until all possible spontaneous recovery had occurred. Many soldiers with toes black on admission here, progressed so favorably on conservative care, that within 2 to 4 months they lost the gangrenous tissue (Fig. 3). A considerable number of these soldiers now have their toes and feet intact. Had they been operated upon early, they would have suffered an unnecessary loss which, originally, could not have been well prognosticated. A few soldiers have been admitted here who were subjected to early amputation elsewhere, and they usually seemed to present greater loss than one would expect should have occurred.



Fig. 5. Above, A flap of normal weight bearing plantar skin and subcutaneous tissue is required as cover for good end stumps.

Fig. 6. All metatarsal heads have been sacrificed to provide good end stumps from plantar skin. This soldier runs and walks surprisingly well.

Another surgical principle that emerged with experience, was concerned with the inadvisability of depending upon grafted skin to cover stumps of feet. The advantages of retaining all possible foot length are obvious, but the attempt to accomplish this by grafting skin to an exposed stump results in a poor foot. Such a foot with an end stump covered with thin skin has no subcutaneous tissue to protect the superficially palpable bone ends (Fig. 4). Weight bearing

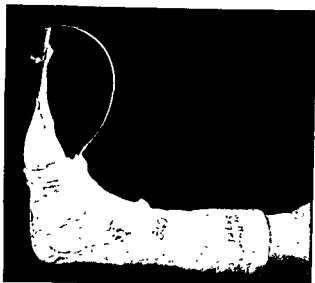


Fig. 7. Skin traction apparatus to assist in closing skin flaps and in preventing skin retraction.

stretches this unpadding skin, which is of low vitality, and it is prone to break down and become the site of an ulcer. Several such patients received here were submitted to corrective surgery. Where good plantar skin flaps, having adequate subcutaneous tissue, were brought up to cover end stumps, good functional feet were obtained. This plantar type of skin and subcutaneous tissue is highly specialized for weight bearing and when pads of it cover bone ends, the stumps are well protected against trauma.

In order to gain this type of end covering pad when gangrene has extended proximal to the webs of toes, it was sometimes necessary to foreshorten metatarsals by removing their heads. Contrary to general surgical opinion, removal of the first metatarsal head, or the fifth—or any—or all five, does not usually too seriously handicap function of the foot. As a surgical principle these heads were removed without hesitation, if that was necessary to obtain enough skin and subcutaneous tissue, particularly from plantar flaps, to cover stump ends (Figs. 5 and 6).

Another surgical principle concerned the method of obtaining closure of the stump. All of these feet were infected, in the sense that bacteriological smears and cultures could be obtained from the demarcation line, but few were chronically inflamed in the area of proximate viable tissue. At first, true guillotine type amputations were done. These required secondary surgery when prolonged skin traction was not completely successful, and the resultant secondary surgery meant additional loss of toe or foot length. Con-

sequently, it became general practice, even on toes, to leave generous flaps to cover the stumps. Where possible, these flaps were fashioned from the plantar surface. Secondary closure, at first done on the fifth day if the stump was clinically free from infection, was advanced with increasing experience, to the fourth and third days, until ultimately, primary closures were done. This was safe because of the postoperative routine presently to be described.

In some early instances when the first metatarsal head was removed, the sesamoids were allowed to remain. They became secondarily chronically infected and were the source of draining plantar sinuses. Even in some disarticulations in which the metatarsal heads were not removed, this was still true. Because these sesamoids had to be removed later, it became a policy to remove them carefully at the original operation, except in those cases in which the metatarsal head was allowed to remain, and in which, further, the sesamoids were safely deep from the edge of the plantar skin flap and clearly surrounded by viable tissue. Under these latter circumstances, they were not disturbed, and none so selected gave further trouble. In fact, they no doubt were useful in helping make up the normal bulk of the resilient pad beneath the first metatarsal head.

An additional surgical principle that frequently proved helpful in taking strain off a suture line and preventing retraction of skin, or occasionally in aiding the approximation of a secondarily infected stump, was skin traction (Fig. 7). Traction was provided by gluing a short length of stockinet on to the foot with ace adherent. Counter traction was obtained by suspending a spring metal hook over the stump and anchoring this hook into a plaster boot. The boot extended to just below the knee, and held the foot at a right angle. This boot loosely covered much of the stockinet but was quite free from fixed contact with it. A spreader with eight to ten rake teeth was hooked into the stockinet and suspended from the boot hook by means of a short length of rubber tubing under considerable tension.

In a few instances having short foot stumps, no additional plantar skin was available to bring up over stump ends. Some of these feet with good ankle motion and adequate plantar walking surface were not condemned to amputation. Instead, full thickness skin flaps were employed to cover the stumps. Either cross leg flaps or jumped tubes were used. Similar plastic procedures were required to cover a few denuded heels.

Additional operative procedures, usually thought of in association with trench foot, have not been



done here. There has been no place for either sympathetic block or sympathectomy.

*Surgical technique.* All amputations were done under pentothal-oxygen anesthesia. Incisions were made just proximal to the typically narrow zone of reaction on the plantar skin. A longer plantar flap and shorter dorsal flap made possible a dorsally placed scar line. Because of lessened tissue viability, together with the bacteriologically positive conditions present, it was a principle not to place buried sutures, absorbable or otherwise, within the amputation stump. As a matter of fact, although bleeding was usually brisk, it was practically never necessary to ligate a vessel.

The periosteum was left undisturbed prior to bone resection. The additional trauma to surrounding soft tissues involved in freeing this periosteum did not aid in the kindly healing of tissues which were, at best, handicapped in viability. Perhaps worth recording is the impression that these stumps and flaps were sometimes not free in their bleeding; that frequently the cancellous bone, on being sectioned, stayed white and free from oozing; that the cortex was usually extremely soft, but at other times was normally dense and brittle and, that now and then, the digital arteries were grossly thrombosed. Regardless of these not so favorable findings, the wounds healed kindly, if somewhat slowly. Closure was either primary, or delayed 2 or 3 days, depending on the gross appearance of the skin flaps. Sutures were fine black silk, sparingly used.

*Postoperative routine.* Following operation, saline dressings were used when a delayed primary closure was being done, and, simple dry dressings for primary closures. Sutures were allowed to remain up to 6 days in the presence of mild postoperative redness and up to 10 or occasionally 12 days if the skin was entirely free from reaction. Sometimes, when it became necessary to remove sutures before healing was complete, adhesive butterflies were useful, but, if left on too long, maceration and undue pressure effects were found beneath the tape. For large stumps in these circumstances, the traction cast previously described was useful.

Postoperatively, penicillin was given in 25,000 unit doses intramuscularly every 3 hours for at least 300,000 units and frequently for 5 or 6 days, or until the sutures had been removed.

The patients were kept off their feet quite a bit longer than one might think necessary. Even after sutures had been removed and the toes or foot stumps seemed well healed, a soldier frequently stubbed a toe, and this sometimes developed a reactive hyperemia or even an acute

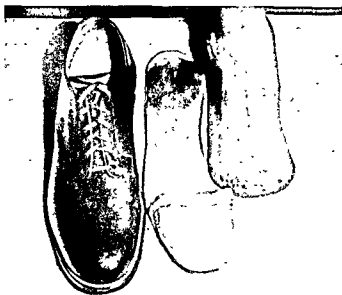


Fig. 8. Prosthesis built on insole for use in standard type shoe.

cellulitis which was slow to resolve. It seemed the tissues lacked resistance to trauma, and being traumatized, lacked resistance to infection. For this reason, a policy of prolonged observation was maintained after definitive treatment had been completed. During this time, of course, the same group physical therapy employed preoperatively, was resumed in normally convalescing cases. Each patient was required to complete 30 days without incident, either on convalescent furlough at home, or at the convalescent hospital, before being given a Certificate of Disability Discharge.

A simple prosthesis has been evolved for all patients who have lost three or more adjacent toes, and for all patients who have lost the metatarsal heads (Fig. 8). Basically, it is a shoe insole, often combined with a longitudinal arch support, and having built on to it a felt block to fill in the space between the foot stump and shoe tip. That part of the felt block nearest the stump is faced with lamb's wool. The rest of the block is covered with thin soft kid leather. In those patients not requiring arch supports, insoles are of thin leather. To prevent the shoes from flexing too much on weight bearing, the tips of the soles are opened and a flat spring steel insert is slipped lengthwise into the soles. By means of these prostheses, the owner can purchase standard shoes, and can wear them without complicated alterations. Using these prostheses, wearers walk more comfortably and more naturally than they do without them.

*Complications.* In about 20 per cent of the cases a slight local redness appeared postoperatively. This transient cellulitis was usually not severe enough to require the removal of sutures,

and penicillin usually seemed to bring it quickly under control. When it was inadequate, one of the *sulfa* drugs sometimes had to be substituted. The cellulitis then promptly disappeared.

Not to be confused with this mild postoperative cellulitis was a different phenomenon of rather similar appearance. When these soldiers began to regain use of their feet, the tissues about the stump ends not infrequently became quite red and angry looking. This condition was associated with neither pain, heat, or swelling, and on resting for a few hours, it completely disappeared. This reactive hyperemia, in response to trauma, as brought about at first by weight bearing, tended to lessen and finally disappear as the days went by. It proved to be of no serious import, but when present, walking was somewhat curtailed.

Except for the mild local cellulitis previously mentioned, postoperative difficulties were few. There were 23 instances of infection with demonstrable pus. These included 4 cases of acute lymphangitis and 1 lumbrical space abscess. Chronic osteomyelitis was surprisingly rare. There were only 5 cases, 1 of these being associated with trench foot in a compounded injury.

Varying types of dermatitis were troublesome in 9 cases. Among these, a temporary generalized urticaria due to penicillin occurred twice, a localized staphylococcus pyoderma was present twice, and a chronic eczematoid dermatitis once. This latter involved all the toes, and the skin was chronically reddened, dry, and scaly.

In these surgical cases, sweating was no problem. In trench foot reports by some, much emphasis has been placed on cold sweating feet. When it is recalled that this phenomenon is part of the characteristic picture of "battle fatigue" and that sweating is frequently present in soldiers who do not have trench foot, and further, that many soldiers with trench foot also have "battle fatigue," one can hardly specify sweating feet as exclusively part of the trench foot picture. In these cases of most severe trench foot, if gangrene is any criterion, there was no more sweating than would be found among a like number of soldiers convalescing from other types of injuries.

Psychologically, the loss of some or all toes, or even the distal portions of one or both feet, has presented no problems that have not been satisfactorily mastered. Probably this is because the soldiers are treated in wards where they are surrounded by others with surgical trench foot.

*Disposition.* Final disposition has been made on most of these cases. None were returned to duty whose feet were not anatomically and symp-

tomatically normal. Therefore, all here reported either have been given certificate of disability discharges, or will be given them when they have reached maximum benefit of hospitalization. Before being discharged, information regarding future care of the feet is given in group talks. All are told that they will continue to improve gradually for as long as 2 years, but that at first they must take measures to guard their feet from undue trauma.

#### SUMMARY

From a total of 4,892 soldiers with trench foot admitted, an experience with 264 cases requiring surgery is recorded. Many additional patients had only a temporary superficial gangrene of the skin of the toes, which spontaneously recovered.

Most patients lost only parts of several toes. Eleven, however, lost all toes of at least one foot, and 32 lost some or all the metatarsal heads as well. With increasing experience, it was found useful to adhere to certain surgical principles. Surgery was delayed until all possible spontaneous recovery had occurred. This saved toes and feet. Grafted skin was found unsuitable for covering stumps. The advantages of covering a stump with a flap of normal weight bearing type plantar skin outweighed the advantages of retaining metatarsal heads. Contrary to general surgical opinion, removal of some or all metatarsal heads was found not too seriously to handicap the function of the foot. At operation, the disadvantages of tying bleeders and of employing a periosteal elevator are mentioned. Sesamoids were removed only when infected or when it was expected they would become infected and cause a postoperative draining sinus. When penicillin was routinely administered, both preoperatively and postoperatively, it was found practicable primarily to close the skin flaps fashioned at the time the gangrenous toes were removed. Infection was rare, and there was no correlation between the frequency of infection and the types of infecting organisms. An effective method of skin traction was sometimes used to help take the strain off suture lines and prevent skin retraction. A postoperative reactive hyperemia on a traumatic basis is described and contrasted to postoperative cellulitis due to infection. Postoperative complications were relatively infrequent. Preoperative and postoperative active exercises helped to prevent shortening of heel cords and correct fibrotic contracture of toes. A prosthesis designed to be part of a shoe insert, often combined with a longitudinal arch support, is described.

# THIOURACIL WILL NOT REPLACE THYROIDECTOMY

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**A**FTER 2 years of clinical experience with thiouracil in the treatment of hyperthyroidism, it is my belief that this drug will not replace thyroidectomy, despite the enthusiastic reports accorded it in the literature. Such claims that thiouracil is the method of choice in the treatment of toxic goiter are unscientific. The facts were better stated in an editorial in the *Journal of the American Medical Association*, September 16, 1944, as follows: "Whether or not thiouracil will prove to be a satisfactory substitute for surgical treatment of toxic goiter cannot be stated on the basis of present limited experience. The drug promises to be of great value in cases in which operation is inadvisable or contraindicated."

Thiouracil will never replace thyroidectomy in the large group of cases commonly designated as multiple toxic adenomas or adenomas with hyperthyroidism. Whether one chooses to designate this group of cases as a distinct clinical entity after the method of Plummer or whether they be considered together with exophthalmic goiter as merely a variation of the same disease makes little material difference. Adenomas are essentially neoplasms and are prone to affect the patient in many other ways than through their toxicity and, as such, require surgical removal. One should surely hesitate to advise the relief of hyperthyroidism in a case of this kind and then see the patient later succumb to a malignancy or the effects of an intrathoracic goiter. Consequently, fully 40 per cent of the so called toxic goiters have been eliminated from the category of successful treatment by thiouracil.

There remains the group of cases commonly spoken of as exophthalmic goiter (diffuse toxic goiter—Basedow's disease, Graves' disease, etc.). In this type much more investigation and study will be required before any considerable number of cases may be judged as cured. In a small series of 35 cases I would hesitate to say that any might be considered as cured judging from the short period of time they have been under observation. Furthermore, experience seems to favor the opinion that the majority of cases of this type should not be subjected to treatment with thiouracil on the basis of our present knowledge of the

drug. In a recent discussion of the subject mention was made of the fact that 27 fatal cases of agranulocytosis occurring from the use of thiouracil had been reported up to that time. This is an exceedingly high mortality in comparison with that for the operative treatment of the average case of exophthalmic goiter in the hands of the experienced thyroid surgeon. Patients residing at a distance find it inconvenient to report for frequent blood counts, and thus is augmented the possibility of the development of agranulocytosis.

If the health of the average patient suffering from exophthalmic goiter may be restored by surgery within a few weeks and he resume his usual duties with a normal metabolism, there seems little justification in subjecting him to months or years of therapy with an admittedly dangerous drug. Furthermore, we agree with Lahey<sup>1</sup>, who is of the opinion that since thiouracil in no way changes the histologic picture of exophthalmic goiter, it is not a drug to be employed as a curative agent.

There are, however, certain indications in which the risk of using thiouracil seems definitely justified in comparison with the risk of surgery. These indications previously indicated<sup>2</sup> might be enumerated as follows:

1. Advanced cases of multiple toxic adenoma in which there is no response to iodine.
2. Cases of toxic adenoma complicated by such conditions as myocarditis, fibrillation, hypertension, diabetes, and decompensation.
3. Cases of severe exophthalmic goiter in such patients as the very young, the aged, the debilitated, and the decompensated.
4. Cases of exophthalmic goiter in whom because of pregnancy, previous nerve injury, infections, or other diseases it may be desirable to delay surgery and yet not continue on iodine.
5. Cases of iodine-fast exophthalmic goiter.
6. Cases of recurrent or persistent hyperthyroidism.

Our experience in all these types of cases with thiouracil has proved encouraging. Probably the gravest risk in the surgical treatment of hyperthyroidism has been brought under control, namely, the advanced cases of toxic adenoma in which a two stage thyroidectomy has usually

<sup>1</sup>The Freda Meyers Nishan Foundation for the Study of Goiter of the Jackson Clinic.

<sup>2</sup>Lahey, F. H. *Kan. City M. J.*, 1945, July-Aug., p. 11.  
<sup>3</sup>Jackson, A. S. *Am. J. Surg.*, 1945, 67: 467-478.



Fig. 1.



Fig. 2.



Fig. 3

Fig. 1. No. 124-539. Case of multiple, toxic adenoma of the thyroid. Basal metabolic rate, +60 per cent. Primary thyroidectomy following thiouracil preparation. Patient did remarkably well and had no postoperative reaction.

Fig. 2. No. 117-399. Case of advanced, multiple, toxic adenoma of the thyroid with chronic myocarditis. Poor surgical risk. Right lobectomy 1943, but too bad a risk for

second stage. Symptomatically controlled with thiouracil. Basal metabolic rate, 0.

Fig. 3. No. 124-564. Case of exophthalmic goiter in an 11 year old child. Clinically, not satisfactorily controlled with thiouracil. Two stage thyroidectomy. Preoperative basal metabolic rate, +38 per cent, pulse 111, weight 73 pounds. Six months later basal metabolic rate, -1 per cent, pulse 80, weight 85 pounds.

been required to safeguard the patient. After several weeks of preparation with thiouracil, I have successfully performed a one stage thyroidectomy in 12 of these cases. Likewise, in several cases in which the systolic blood pressure was in excess of 225 and in which the threshold of cardiac reserve was small, thiouracil has appeared to reduce the risk considerably.

There has been an opportunity to use the drug in children in only 3 patients having exophthalmic goiter. An 11 year old child was on treatment for 13 months and now shows an unfavorable response since the drug was withdrawn 3 months ago. Another child of a similar age was kept on the drug for several months with unsatisfactory results and then underwent a successful two stage thyroidectomy. A third child is now on treatment with insufficient time elapsed to draw any conclusions.

An interesting case is that of an 18 year old girl who sustained a bilateral adductor laryngeal paralysis, the result of a thyroidectomy performed previous to her admittance to the Jackson Clinic on April 1, 1943. In December, 1943, treatment with thiouracil was started because she

had had a recurrence of the hyperthyroidism and because the risk of surgery was out of proportion to the danger of using the drug. Three months ago (July, 1945) therapy was discontinued, and so far the patient has retained her weight and a normal metabolism.

At the present time I have under observation a woman who is 8 months pregnant and who has a moderately severe exophthalmic goiter. In the past I have performed thyroidectomy in a series of 15 cases of this type with no mortalities in either the mother or child. However, in none of these cases was the patient so near to term, the average being 5 months. Consequently, it seemed inadvisable to carry these patients along on iodine until the time of delivery because of the danger of inducing an iodine-fast state. The case now under treatment has been on thiouracil for 2 months and is in excellent condition. Probably thyroidectomy will be performed about a month after delivery.

The term "iodine-fast" exophthalmic goiter was suggested by the writer at the 1931 meeting at Denver of the American Association for the Study of Goiter.<sup>1</sup> At the time it was described as

<sup>1</sup>Jackson, A. S. West J. Surg., 1932, 40: 142-149.



Fig. 4.



Fig. 5.



Fig. 6.

Fig. 4. No. 113-573. Case of recurrent exophthalmic goiter with bilateral adductor paralysis of the recurrent laryngeal nerve. Thyroidectomy performed elsewhere. Symptomatically controlled on thiouracil since December, 1943.

Fig. 5. No. 123-459. Case of exophthalmic goiter. Basal metabolic rate, +41 per cent, pulse 124. Excellent preopera-

tive response to thiouracil and Lugol's solution. Prepared for thyroidectomy; very little reaction. Six months after operation, basal metabolic rate, +15 per cent, pulse 102, weight gain.

Fig. 6. No. 124-717. Case of multiple, toxic nodular goiter with diabetes. Prepared with thiouracil for thyroidectomy.

a new syndrome, one might even say a distinct clinical entity, in which all the classical signs and symptoms of exophthalmic goiter may be absent. Cases are seen in which there is no thrill, no bruit, no tremor, no exophthalmos, and no weight loss. In fact, these patients may even gain in weight. The gland, instead of being firm, smooth, and symmetrical, is nodular and irregular from prolonged, partially controlled hyperthyroidism. There is no clinical response to iodine. Surgeons have come to look upon these cases with considerable apprehension and to consider the surgical risk as comparable to that in advanced cases of multiple toxic adenoma. Usually a two stage thyroidectomy has been required and even then the reaction that followed a lobectomy was often as severe as in a similar operation performed in the era previous to the use of Lugol's solution. Thiouracil has proved a boon to the patient and surgeon alike in the treatment of these patients. In our clinic 5 patients with this type of thyroid disease have been operated upon—a primary thyroidectomy being done after several weeks of preparation with thiouracil. All of them showed no more than the average reaction to operation.

Those working in the field of thyroid disease have never felt that thyroidectomy was a real method of treatment of exophthalmic goiter. It speaks of a cure in this disease, but it is the treatment of cancer, rather than of a disease because of the well known tendency of the disease to recur months or years after apparently successful thyroidectomy. It has been the hope of all who have been concerned of hyperthyroidism that there would be a more satisfactory method of treatment uncovered. When Plummer first suggested the use of Lugol's solution, it was thought some that this might effect a permanent cure of recurrent or persistent hyperthyroidism. It has proved to be true, but it has not been eliminated its use for the treatment of many such cases are still being treated. Crile advocated the use of Lugol's solution as a method of preparing the patient for thyroidectomy. This operation was performed in many cases and fall into dispute with the thyroidectomy procedure.

Now thiouracil is brought forth as a method of replacing thyroidectomy in the treatment of hyperthyroidism. Chemotherapy may prove to be the solution to the successful treatment of hyperthyroidism, cancer, and many other diseases, but as yet it has not attained the success of the sulfonamides in the infectious conditions. It now appears that thiouracil has been under sufficient clinical investigation to state that it will supplement but not supplant thyroidectomy in the treatment of hyperthyroidism. That it may effect a cure in incipient and milder cases of exophthalmic goiter is still to be proved. It has already proved a most valuable adjunct to surgery in the treatment of hyperthyroidism. There is every hope that thiouracil will give way to some less toxic but still more efficacious drug in the treatment of hyperthyroidism. Its discovery is a step forward, and those dealing in the problems of hyperthyroidism are greatly appreciative of investigators who have made thiouracil available.

#### CONCLUSIONS

Two years of study of the use of thiouracil in the treatment of hyperthyroidism have shown that it will not replace thyroidectomy.

Thiouracil will supplement but not supplant surgery in the treatment of toxic goiter.

It has been noted that 27 deaths have already been reported as occurring following the use of the drug.

Thiouracil cannot effect a cure in toxic adenoma.

Six types of cases are listed in which thiouracil has proved of definite value.

Thiouracil may prove of curative value in the treatment of exophthalmic goiter, but sufficient time has not yet elapsed to warrant such a conclusion.

While the use of thiouracil has proved an important forward step in the treatment of hyperthyroidism by chemotherapy, it is desirable that a less toxic drug be discovered.

# FEEDING TUBE STENOSIS OF THE LARYNX

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THE indwelling nasal tube, employed chiefly for gastric decompression or for feeding purposes, is so widely used that it is important to draw attention to the possibility of laryngeal damage it may produce. Instances of this complication are relatively uncommon, but, when they do occur, constitute a difficult therapeutic problem. The indwelling tube in the cases to be discussed was the cause of erosion of the anterior esophageal wall at the level of the cricoid cartilage, with subsequent inflammation of the laryngeal cartilages and their ultimate necrosis. This pathological sequence led to a collapse of the airway and a severe, chronic laryngeal stenosis which required tracheotomy and months or years of subsequent treatment. This discussion is presented to call attention to this serious complication and to stress the predisposing as well as exciting etiological factors responsible for it. Through an understanding of these factors, the recognition of early symptoms and the prompt execution of simple corrective measures will prevent the development of this type of chronic laryngeal stenosis.

## PRESENTATION OF CASES

CASE 1. N.G., a 52 year old white Polish housewife, was seen first at the Research and Educational Hospital in March, 1939. She was found to have diabetes mellitus and a large, cystic, firm thyroid without toxic symptoms, but with definite compression symptoms. Her basal metabolic rate was +11 and her fasting blood sugar was 333. She was placed under medical management until August, 1939, when a subtotal thyroidectomy was performed. She had no hoarseness or breathing difficulties following this procedure, and her recovery, while slow, was uneventful. In April, 1940 the patient developed severe pain in the right lumbar area which radiated anteriorly to the right lower quadrant and into the vulvar area. The pain was severe, constant, sharp, and was associated with nausea and vomiting. The pain apparently was an aggravation of a dull pain of which the patient had been complaining for 4 months. On admission her temperature was 101.6 degrees; white blood count, 19,300; and her blood sugar was 250 milligrams per cent.

A tentative diagnosis of an appendiceal abscess was made, and an indwelling duodenal tube was introduced April 17, 1940. The patient was very intolerant of the tube because of discomfort and pain, and made frequent attempts to remove it manually or by vomiting. It was left in place for 4 days. No abdominal surgery was per-

formed as the diabetes was out of control although she received adequate insulin and intravenous glucose therapy. By the time the tube was removed the diabetes had been controlled and the abdominal pain had almost completely subsided. However, the patient complained of an increasingly severe sore throat which began at the time the tube was introduced and continued even after it was removed. She would take only liquids, refusing solids because of pain on swallowing. Hoarseness developed after the tube was removed. The tenderness in the right lower quadrant gradually decreased, and her problem became one of respiratory difficulty. An indirect laryngoscopy on May 4, 1940, revealed considerable edema of the vocal cords; it was difficult for her to make audible sounds.

By the sixth week of hospitalization, pain in the right side of the neck and respiratory difficulty had increased markedly. The larynx was more edematous, especially posteriorly; the arytenoids were large and boggy with edema, and the motility of the cords was impaired by the edema, but no paralysis was present (Fig. 1). A tracheotomy had to be done June 3, 1940. Clinical improvement was slow and x-ray films of the neck demonstrated a progressive destruction of laryngeal cartilages as well as a spread of the laryngeal inflammatory process to the soft tissues of the retroesophageal space (Figs. 2 and 3). Chemotherapy was employed, but because of the patient's generally poor condition and the difficulty in controlling her diabetes, extensive surgery of the larynx seemed contraindicated at this time. Purulent drainage into the larynx persisted for 2 months before gradually subsiding. Subsequent treatment has consisted of two series of laryngeal dilations under direct laryngoscopy. At present the patient still wears her tracheotomy tube, but can keep it corked for several hours at a time (Fig. 4). Her voice is husky but audible.

Thus, this patient, a diabetic, had a feeding tube in place for 4 days during which time it caused discomfort, sore throat and pain, and vomiting had occurred. Laryngeal edema subsequently developed, and a tracheotomy became necessary 7 weeks following removal of the tube. The patient now has a chronic laryngeal stenosis which is responding slowly to treatment.

CASE 2. Mrs. E. B., white, 48 year old housewife. In September, 1940 this patient had a gastroenterostomy and a stormy convalescence followed. A nasal tube was in place 17 days. During part of the time the tube was in place the patient complained of a severe sore throat and pain extending into her ears. This subsided temporarily and the patient was discharged from the hospital. The pain recurred in 2 weeks and became very severe; it was followed by laryngeal edema which increased gradually. Four weeks after leaving the hospital readmission became necessary because of respiratory distress, and an emergency tracheotomy had to be done 24 hours later. Improvement was gradual, and the patient was extubated 5 months later. During the ensuing 3 years dyspnea with exertion was

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Fig. 1. Case 1. Lateral roentgenogram of the neck May 28, 1940. A feeding tube had been in place 4 days, 6 weeks prior to this date. Significant postcricoid and arytenoid edema are visualized.

noted, progressing gradually to the point of severe respiratory embarrassment with the least exertion. She was admitted to St. Luke's Hospital at this time, and both the mirror and roentgen examinations demonstrated an extreme subglottic stenosis (Fig. 5). The motility of the



Fig. 3. Case 1. Lateral roentgenogram of the neck July 5, 1940, showing partial destruction of the cricoid cartilage and obliteration of the subglottic airway.



Fig. 2. Case 1. Lateral roentgenogram of the neck June 10, 1940. The cricoid and thyroid cartilages show some mottling and the postcricoid thickening has increased. The airway subglottically narrowed; patient tracheotomized.

larynx was impaired because of cicatricial contractures, but the configuration of the vocal cords was essentially normal. A second tracheotomy was done in March, 1944, and the larynx dilated repeatedly by direct laryngoscopy. The tube was removed in September, 1944, after the patient's



Fig. 4. Case 1. Lateral roentgenogram of the neck after subsidence of the acute inflammatory process. Laryngeal dilatations have resulted in improvement of the airway.



# OBSERVATIONS ON A CONCEPT OF INGUINAL HERNIA REPAIR

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THERE is once more a rising tide of speculation among surgeons as to the actual results of the traditional methods of inguinal hernia repair. There is coincidental reflection of dissatisfaction with such results in the continuing publication of alternative methods of radical revision of the abdominal wall. Statistics are usually furnished in an effort to show that fewer failures have occurred with the recommended technique than in any other series cited by their author from the literature. There is nothing novel about this situation, for in an exceedingly interesting article, to which further reference will be made, Pitzman stated in 1921: "The size and endlessness of the stream of inguinal herniotomy technique raises the strong suspicion that something is fundamentally wrong."

At the time of going on active duty in the Medical Corps, the present writer had a concept of inguinal hernia, which though by no means original, was unorthodox. A rather concentrated experience with this disorder in naval personnel has strengthened his belief in the validity of this concept and in the necessity of including certain technical steps in any plan for achieving correction. It has been impressive to observe the development of a similar point of view among many thoughtful surgeons who, entering service with a more traditional concept of inguinal hernia, have also had the opportunity of daily exploration or observation in this field. In the 20 month period between February 15, 1944, and October 15, 1945, 1,398 operations were done for primary inguinal hernia, 89 operations for recurrent inguinal hernia, and 11 operations for femoral hernia at the United States Naval Hospital, Naval Training Center, Great

Lakes, Illinois. Due to the exigencies of the service, tabulation of the operative findings has not been completed, but reference will be made in this paper to observations on which those of us who had duty there during that period are in agreement. Sliding hernia will be excluded from consideration.

A critical review of the literature for the last 10 years leaves the writer with one conviction which is very disappointing (his own position as unorthodox having been stated): there is no published evidence that in any group of patients with inguinal hernia operated on by the Bassini technique (including such variations in the disposal of the external oblique aponeurosis as are usual), there would have been fewer failures had another operative procedure been chosen! This conclusion is derived from the fact that no standards of reporting have been agreed on. The converse of the first conclusion is that there is no statistical evidence that a surgeon advocating one of the suggested alternatives to the Bassini would have had poorer results had he used the latter. The fact is that far more complete data are available as to the results of operations done by the Bassini method than of any, including that advocated by the writer, intended to supplant it. Those who may question these assertions will find their answer when they seek to apply to the published statistics of any given procedure the best facts available as to the relationship between the intervals (in years) after operation and the percentages of recurrences. Burdick and Shelley (16, 17, 18) in analyzing their own recurrences detected in yearly follow-up examinations, found that in 284 and 210 traced recurrences, respectively, less than one-half were found in the first year and approximately two-thirds in the first 2 years; about 83 per cent were detected in the first 5 years in each series and the remainder thereafter. It happened that the overwhelming majority of pa-

The views expressed herein are those of the author and are not to be construed as those of the Bureau of Medicine and Surgery or of the Navy Department.

Read before the Western Surgical Association, November 30, 1945.



Fig. 5. Case 2. Lateral view of the neck showing partial destruction of the cricoid cartilage, postcricoid thickening, and reduction in the airway at the level of the cricoid cartilage. Arrow indicates the stenosis at level of cricoid.



Fig. 6. Case 3. Lateral view of the neck showing the postcricoid thickening and narrowing of the airway at the level of the cricoid cartilage. The principal area of stenosis was immediately subglottic.

airway was tested by plugging the tube night and day for several days.

In this case an extremely ill patient had a nasal stomach tube in place for 17 days during which time a sore throat and pain in the neck and ears developed. Symptoms improved following removal of the tube, only to recur in 2 weeks and increase in severity to a degree requiring tracheotomy. This was done 1 month after removal of the feeding tube. Eventual subsidence of the process resulted in a chronic laryngeal stenosis for which a second tracheotomy had to be done to permit adequate treatment. At present she breathes freely without a tracheotomy and has a clear voice.

Case 3. Mrs. E.A., secretary, white, 43 years of age. This patient had had four operations for gall-bladder disease between 1926 and 1940. In December, 1940, a fifth operation was performed and a nasal tube was left in place 7 days. The tube annoyed the patient considerably, causing a sore throat and considerable gagging, but the patient states she did not vomit. Symptoms improved following removal of the tube, but the sore throat became worse a week later, and gradually localized as severe pain deep in the neck, aggravated distressingly with swallowing. The patient developed hoarseness and then a complete aphonia 3 weeks later. Dyspnea began suddenly one night in February, 1941, and an emergency tracheotomy was done. Attempts to extubate her subsequently were unsuccessful. The patient was referred to St. Luke's Hospital in August, 1941, for laryngeal examinations. At this time the stenosis of the larynx was almost complete. The true cords could not be satisfactorily exposed because of marked anteroposterior compression of the larynx. Small bougies were



Fig. 7. Case 4. View of the hypopharynx and esophagus from behind showing the ulcerated postcricoid mucosa and exposure of the posterior surface of the cricoid cartilage. A indicates the maxillary arch of the posterior cricoid cartilage forming the base of the ulcer.

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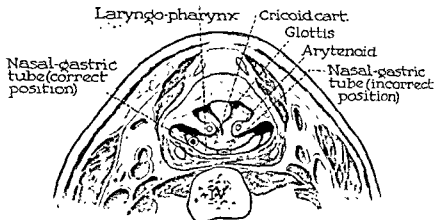


Fig 8. Drawing of the horizontal section of the neck at the level of the 4th cervical vertebra and the cricoid cartilage showing the correct and incorrect positions of the feeding tube and the compression of the tube when in the incorrect position.

passed through what appeared to be the laryngeal aperture, but they met with considerable resistance. By means of laryngeal dilators a definite lumen was re-established and the patient could then phonate again by manually closing her tube. The examination demonstrated that the principal area of stenosis was immediately subglottic (Fig. 6). Dilatations were carried out at frequent intervals but the larynx never remained open sufficiently to permit removal of the tube. However, a valve tube was substituted for the original tube, and the patient is now able to speak well with the valve tube without manually closing the tube. At present she holds an important executive position and carries on all conversation without difficulty.

In this case the nasal stomach tube was in place 7 days and caused a sore throat and gagging, but no appreciable pain. After its removal, pain, hoarseness, and later aphonia developed. Approximately 6 weeks elapsed from the time the feeding tube was removed until the tracheotomy had to be done. The patient now has a chronic laryngeal stenosis and is wearing a valve tracheotomy tube. She refuses further surgery because she has a satisfactory functional result.

CASE 4 A.M., 57 year old white female entered the Research and Educational Hospital on April 16, 1940, complaining of lower abdominal pain of 8 weeks' duration and persistent vomiting of 3 weeks' duration. The abdomen was distended with fluid, and rectal examination revealed a hard, fixed mass anterior to the rectum. Tumor cells were found in fluid removed by abdominal paracentesis. An exploratory laparotomy done 3 days after admission demonstrated an extensive carcinomatosis. Gastroenterostomy was done because of almost complete obstruction of the pylorus by the tumor. A stomach tube had been inserted when the patient entered the hospital and it remained in place for 5 days. It was then removed, and reinserted three times during the following 6 days; it was always tolerated poorly. The entire surgical wound opened on the eighth postoperative day. Reinsertion of the stomach tube at this time was associated with considerable trauma. The tube was withdrawn in an hour because gastric contents were not recovered. The overzealous attempt to insert the

tube resulted in a perforation of the esophagus and the patient expired 3 days later of the combined effects of the abdominal and mediastinal pathology. The primary tumor was found to be a papillary cystadenocarcinoma of the right ovary with extensive metastases. Postmortem examination of the esophagus demonstrated a deep ulcer 4 centimeters in length in the mucosa covering the posterior aspect of the cricoid cartilage (Fig. 7). The ulcer extended through all the walls of the esophagus and exposed an area of the cricoid cartilage which then made up the base of the ulcer. The cartilage itself was roughened and necrotic in this area. A recent perforation of the left pyriform sinus was found which led into a necrotic mediastinal abscess. The postcricoid erosion seemed older than the perforation and was distal to it. It was undoubtedly present before the final attempts were made to reintroduce the tube.

While this patient did not have a true feeding tube stenosis of the larynx, the postmortem examination of the larynx demonstrates the earlier phase in the process which ultimately leads to the development of stenosis. The stomach tube was in place a total of 6 or 7 days, always poorly tolerated. The presence of the ulcer across the slightly convex posterior surface of the cricoid cartilage is significant in that the cartilage is thus exposed to the action of bacteria as well as to the chemical action of regurgitated gastric contents.

#### DISCUSSION

Various types of rubber tubes have long been used for emptying the stomach or for feeding purposes. The type known as the Levin tube is usually employed, as it is of smaller caliber and more pliable rubber than the larger tubes. The continuous suction technique using this tube, as employed by Wangenstein (6), has resulted in widespread use of the Levin tube for relatively long uninterrupted periods. Passed through the nose, it descends into the pharynx, the laryngopharynx, the esophagus.

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### THE PROTEIN NUTRITION OF SURGICAL PATIENTS

THAT the surgeon should be concerned with the chemical and physiological aspects of his patients is now such a well known fact that it is trite to mention it.<sup>1</sup> There is no form of tissue repair in which the protein metabolism is not concerned. Protein metabolism is also concerned with resistance to infection, and resistance to poisons of various kinds. Serious protein depletion of the body tissues may be present in a large proportion of patients, particularly those who are markedly under weight. Such depletion may be the result of either acute or chronic illness. An acute illness may cause protein depletion with great rapidity, particularly in diarrheal diseases, burns, and major infections. Even in simple major fractures, net losses of protein representing a pound of tissue a day may go on for weeks.

Fortunately, methods to prevent or reduce these net losses are becoming widely available even for patients who cannot eat. Following the pioneer work of Elman,<sup>2</sup> intravenous protein hydrolysates and mixtures of amino acids for intravenous use have been found to be safe and practical, but the latter are not yet available for general use.

Parallel with this development, improved products for oral and intubation feeding have also become available. As one becomes familiar with the results following the use of such substances, the indications for their use become broader. The time has come when surgeons should become thoroughly familiar with the protein requirements of the normal and of the sick individual. In thinking of such requirements, one must be careful to think of the requirements in terms of optimum use rather than in terms of the requirements for bare existence. When time is available to improve protein nutrition before surgery, and when this time is used efficiently for this purpose, the reduction in postoperative shock and other complications is impressive. Under certain conditions indicated in a very suggestive paper of CoTui<sup>3</sup> on gastroduodenal ulcers, improved protein nutrition may even abolish the necessity for surgery. When conditions do not allow time for preoperative repair of protein deficiency, postoperative repair at the earliest moment is very important.

Protein hydrolysates are not an efficient treatment of shock and should not be used during threatened or actual surgical shock. Whole blood is the method of choice in the treatment of this complication, with plasma

<sup>1</sup>Lund, C. C., and Levenson, S. M. *J. Am. M. Ass.*, 1945, 125: 95-100.

<sup>2</sup>Elman, R. *Ann. Surg.*, 1940, 111: 594-602.

<sup>3</sup>CoTui, Wright, A. M., Mulholland, J. H., Galvin, T., Barcham, I., and Gerst, R. *Gastroenterology*, 1945, 5: 5-17.

Active treatment of laryngeal perichondritis once it has developed is exceedingly difficult and often disappointingly ineffectual. Chemotherapy, both the sulfa drugs and penicillin, should be administered, although none of these patients was in the acute stage when penicillin was available and consequently no clinical experience can be recorded. A tracheotomy is indicated, of course, if respiratory embarrassment becomes severe. Surgical drainage and sequestration of the larynx and its cartilages should be postponed, if possible, rather than attempted early, because the cricoid cartilage is the only complete ring in the trachea, and its loss results in a collapse of the airway. No laryngeal instrumentation is done during the acute phase of this condition. Subsequently, however, active laryngeal dilatation or surgical reconstruction of the airway is necessary in order to remove the tracheotomy tube permanently. On occasion it is possible to remove the tracheotomy tube after the acute edema and perichondritis subside. Stenosis may recur in such cases several months or years later as the scar tissue contracts (Case 2).

#### SUMMARY AND CONCLUSIONS

Severe laryngeal destruction occasionally results from the routine use of nasal feeding or gastric suction tubes. Fortunately this complication is rare; however, it is so severe when it does occur that it is important to be aware of the possibility of this complication and to recognize its beginning symptoms at once.

Four cases are presented. In 3, rubber nasal stomach tubes were used, 4, 17, and 7 days,

respectively, during which time the patients complained of discomfort due to the tube. Symptoms increased with sore throat, pain radiating into the ears, pain on swallowing, hoarseness, and finally dyspnea. Tracheotomies had to be done in these 3 cases 4 to 6 weeks after removal of the stomach tubes. All developed severe chronic laryngeal stenoses. One has been extubated, one wears a valve tracheotomy tube, and the third is still under treatment. The fourth patient died as the result of extensive carcinomatosis and mediastinitis. Postmortem examination demonstrated the ulcer which had not as yet caused laryngeal destruction.

A review of the literature reveals 24 recorded cases similar to those herein described.

Treatment consists of removing or changing the position of a feeding tube if the patient complains of a sore throat, and especially if hoarseness or pain in the ears develops. Active treatment, aside from chemotherapy, consists of tracheotomy, drainage, and subsequent laryngeal dilatation or plastic repair.

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surgeon a better degree of control over the patient's intake than any previous method of feeding. When such feeding is used for any condition other than burns or other than conditions where chronic salt depletion has been demonstrated, the amount of added salt should be greatly reduced or eliminated entirely. When a patient cannot or will not take this diet, tube feeding may be indicated and such a mixture may have powdered yeast and more amigen added because palatability is not a factor. A suitable formula for this consists of:

#### HIGH PROTEIN MIXTURE FOR TUBE FEEDING

		Cbh.	Prot.	Fat	Calories
Skim milk	3.0 L	150	110	6	1094
Skim milk powder	200 G	78	60	6	508
Amigen powder	200 G	0	150	0	600
Valentine's liver extract	30 cc.	0	2	0	8
Brewer's yeast powder	30 G	12	14	1	113
Salt	15 G	0	0	0	0
		140	336	13	2413

The patients who need these types of oral or tube feeding also need vitamins, but over a long period of time probably do not need as high a dose of vitamins as the patients who are receiving parenteral protein feedings. Suggested oral daily doses for these patients would be vitamin A, 30,000 units; vitamin D, 3,000 units; ascorbic acid, 500 milligrams; thiamin, 20 milligrams; riboflavin, 12 milligrams; and niacin, 100 milligrams.

Charles C. Lund.

surgeon is now primarily an excellent physiologist and only secondarily a technician. The time and care which we all devote to the nutritional and electrolytic requirements of the body, both preoperatively and postoperatively, forcefully attest this fact.

Nowhere is this progress more clearly reflected than in the modern treatment of congenital hypertrophic pyloric stenosis, because nowhere else do we find such an extreme lability of this homeostatic mechanism. Man, who may be considered the most competent animal, produces the most helpless young, and this helplessness extends all the way from inability to avoid physical danger to inability to maintain a stable internal environment except under the most favorable circumstances. Obviously, therefore, when an infant of two or three weeks of age begins to vomit everything taken by mouth it will be but a short time before extreme dehydration and loss of electrolytes will so disrupt the delicately balanced biochemistry of his body that continuance of life will become endangered. While these facts are now so evident that to repeat them is almost tautological, it was but a few years ago that these acutely ill, dehydrated babies were subjected to emergency surgery. The surprising fact is that the operative mortality was only 35 to 40 per cent.

It seems to me that we were all very slow in realizing that these babies needed emergency "physiology" rather than surgery. They were desperately, albeit weakly, crying to us to replace their fluids and electrolytes so that they might survive this crisis which was threatening their existence. Having finally awakened to an understanding of these biochemical disturbances and having taken proper steps to aid the infant to correct them, it soon became obvious that the operation could be delayed several days, if necessary, until hydration was accomplished. Lowered mortality resulted.

#### CONGENITAL HYPERTROPHIC PYLORIC STENOSIS

THE past quarter century has shown remarkable progress in the surgical management of most abdominal conditions and much of this seems to be due to our increased understanding of what Cannon has referred to as homeostasis. The

and human albumin as effective agents to be used temporarily. Immediately after the danger of shock is over, protein hydrolysate or food may be given.

Plasma is being widely used in an attempt to repair protein deficiency. This is not an efficient method of treatment for this purpose. Whether money has to be paid for plasma or not, by the hospital or by the patient, plasma is a very expensive material. It has been calculated that the protein in plasma costs at least one dollar per gram. The corresponding price for lean hamburger steak in a generous serving of  $\frac{1}{3}$  of a pound would be about twenty-five dollars. As a treatment for hypoproteinemic patients, one must also remember that plasma contains a great deal of sodium in the form of the original sodium chloride in the blood plus a generous amount of sodium in the form of citrate added to prevent clotting. When plasma is used in large quantities in the patient with true hypoproteinemia, increased edema and heart failure may well result.

Under conditions of severe burns or severe depletion from various infections or intestinal disabilities up to 400 or 500 grams of protein per day may be life-saving. Up to 150 grams per day of protein can be given intravenously in the form of hydrolysates or other similar preparations. Glucose may be and should be added to these hydrolysates because of its protein sparing effect. A formula suitable for many conditions has been suggested by Butler<sup>1</sup> and consists of 1 liter of amigen plus 300 cubic centimeters of 50 per cent glucose. This cannot be given in less than 4 or 5 hours because rapid administration causes nausea and vomiting, and if given into a moderate sized vein, seldom causes thrombosis. Three such injections a day will furnish 150 grams

of protein and 600 grams of carbohydrate. This amount of food represents 3000 calories.

Experience has shown that vitamins should be added to such a mixture in generous amounts for the patients who are sick enough to warrant this treatment. There is apparently very little wastage if 1 gram of ascorbic acid, 200 milligrams of niacin, 20 milligrams of riboflavin, and 20 milligrams of thiamin are given to such a patient at some time during each 24 hours.<sup>2</sup> Oral feeding or tube feeding to the hypoproteinemic patient or the patient in whom efforts are being made to avoid hypoproteinemia, should be in the form of mixtures of protein and carbohydrates with a minimum of fat. The following formula has been taken over periods of months by patients with burns which were so extensive that early grafting of the whole area was impossible.

HIGH PROTEIN MIXTURE FOR ORAL FEEDING

		Cbh	Prot	Fat	Calories
Skim milk	30 L	150	110	6	106
Skim milk powder	300 G	117	90	6	11
Amigen powder	100 G	0	25	0	600
Valentine's liver extract	30 cc	0	2	0	1
Salt	15 G	0	0	0	0
		267	227	22	1178

This mixture makes up a large part of the food necessary for 24 hours and should be given in 8 ounce portions every two hours day and night. The patient taking this will have little appetite for any other food, but meat and carbohydrate food may be given immediately after at least three liquid feedings. Such a regimen avoids the very serious difficulty of the patient with a poor appetite choosing the more palatable but less important nutritional elements from an ordinary high protein diet tray and gives the

<sup>1</sup>Butler, A. M., and Talbot, N. B. *N. England J. M.*, 1944, 231: 621-623.

<sup>2</sup>Levenson, S. M., Green, R. W., Taylor, F. H. L., Johnson, F. Page, R. G., Johnson, R. L., and Lamb, C. C. *Ann. Surg.* (a press.)

# THE SURGEON'S LIBRARY

## REVIEWS OF NEW BOOKS

AS may be judged from the title, the two volume, 1200 page work *Surgical Treatment of the Motor-Skeletal System* by Bancroft and Murray<sup>1</sup>, embraces the entire field of traumatic and non-traumatic orthopedic surgery. While created and fostered by the Division of Orthopedic Surgery at Columbia University, the collaborators number 43 men whose individual work and writings have made them outstanding in the fields of their special interests.

The majority of the authors are from the Eastern schools and clinics, but the overall impression is gained that no personal, group, or sectional viewpoint is stressed. Certain principles and methods of treatment are, of course, emphasized, because the author, in a number of instances, has originated them or has been responsible for their wide acceptance. For example, it would be expected that Dr. von Lackum would present the subject of scoliosis as he does, for much of our present management of this condition comes from the work of the New York Orthopedic Hospital Staff. Dr. Kite, who has made an art of the wedged cast treatment of foot deformities, naturally devotes more space to this method than to others. It is to be regretted that some of the articles were completed before the newer concepts of chemotherapy were generally accepted, but the editors have overcome this to some extent, in that they have written on chemotherapy as it applies to all the infections attacking the skeletal system. An example of this may be found in Dr. Beekman's chapter on osteomyelitis. This chapter is also an example of the thoroughness with which various conditions are discussed. Dr. Beekman draws on his wide experience in the Children's Surgical Service at Bellevue Hospital, so that an excellent background on osteomyelitis can be obtained by reading this chapter. Some of the newer concepts, more or less experimental at the time this work was completed, can be found in the section on chemotherapy.

It was somewhat disappointing to find nowhere in the book a chapter dealing entirely with the infections, injuries, and other conditions of the hand. One interested in looking up something in this field would be forced to seek through many chapters before finding the specific information required. The chapter entitled "Military Surgery" adds little to the usefulness of the book, but of course one may suggest that most of the important work that came out of the war is included other places.

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The general scheme of the volumes suggests that much thought was given to the presentation plan and this, plus the unusual activity of Dr. Murray, whose own views are many times expressed aptly if not sharply, makes it a fully adequate survey. The presentation of each subject is followed by a brief but comprehensive bibliography containing the citation of really important work that has been done in that particular field. Most reviewers will agree that there is a uniformity and smoothness of style throughout which is not found in the usual medical text by multiple collaborators, and this absence of encyclopedic jerkiness will be an incentive to become cover-to-cover readers of the two volumes. This was true of the undersigned, and it is something he has seldom before done.

It is impossible to discuss in detail all of the many chapters. The man interested in a particular problem at hand is sure to find complete and authoritative information. On the other hand the student, whose task it is to read for general rather than specific information will find his needs well filled. I know of no two volumes available now that would be more useful in the school years or afterward than this splendid work.

JAMES K. STACK.

EDITED by W. G. Barnard and A. H. T. Robb-Smith *Kettle's Pathology of Tumours*<sup>2</sup> is a most concise treatise. Since it was written for students, it is a didactic presentation with but little argumentation and few references to source material. Present day ideas in tumor fundamentals are adhered to generally. The development of this third edition (1946) is shown most strikingly if one compares certain sections in it with those of the first edition (1916). The sections on etiology, tumors of the lungs, and tumors of the nervous system have altered so much in these 30 years that they are entirely new concepts. Also in keeping with present times is the inclusion of a section on trauma and on occupation in relation to tumors. The book is richly illustrated by nearly 200 drawings and photomicrographs in approximately 300 pages of text.

HAMILTON R. FISHBACK.

THE two pocket books *Lecciones de cirugía*<sup>3</sup> are the first of a series to appear in the future. They are intended to give a written account of the Postgraduate Surgical Instruction as carried out on the

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At first these infants were given blood transfusions routinely as preoperative preparation. Later it was found that the parenteral administration of physiological solutions of glucose and saline produced the same result with fewer complications and less expense. Transfusions were then reserved for the infants which showed advanced dehydration, and were used in conjunction with the parenterally administered electrolyte solutions. Increased experience in this direction produced a further decrease in mortality.

Another factor which has improved the outlook for these babies has been the more prompt recognition of the disease. The typical and almost constant history of the infant who does very well for the first two weeks of life, then begins to regurgitate part of his feedings, then to vomit the whole feedings and finally to develop the characteristic projectile vomiting of bile free fluid, has become so well known to the medical profession that these babies are sent immediately to the hospital. They therefore arrive in much better condition and frequently they can be prepared in two or three days for surgical cure.

Usually, on arrival at the hospital, they are dehydrated, constipated, pass only small amounts of concentrated urine, and show visible peristaltic waves travelling across the abdomen. Palpation, especially when the stomach is empty, will reveal the pyloric tumor which is pathognomonic of the disease. Restoration of body fluids, electrolytes and, if necessary, serum proteins, is promptly begun, and, when restoration has been accomplished as demonstrated by clinical observation and the judicious use of laboratory tests, with probably major emphasis on the former method, surgery should be undertaken at that time.

The ultimate cure in every case seems to lie in the Fredet-Rammstedt operation, because it gives a permanent result and is very simple and rapid in its execution. We prefer a right rectus incision placed so high that the right lobe of the liver must be displaced upward to expose the pylorus. Great care must be used in dividing and spreading the hypertrophied pyloric musculature so that no damage to the underlying mucosa occurs. After careful layer-by-layer closure of the abdomen, the healing incision being effectively buttressed by the liver, we are reasonably insured against postoperative wound dehiscence.

After operation the baby should be kept in a room where the temperature is constant and where he is completely isolated from all other cases. Everyone who enters the room should wear a clean gown and mask. Extreme gentleness in handling the baby and the use of a small cane sugar pacifier at the time of wound dressings are of course, mandatory.

The surgical mortality in this condition at the present time is about 1.2 per cent. We are convinced that with proper preoperative, operative, and postoperative care, mortality should be about zero as far as the operation is concerned. Because the surgical mortality and morbidity are so low, we never consider prolonged medical treatment such as refeeding after vomiting, feeding by gavage, etc. The facts that ten days after this operation the baby is gaining weight and hungrily taking a generous evaporated milk formula and, that within three to four weeks, he has regained the position he would have held had he never had pyloric stenosis are convincing evidence of the efficacy of the operative method in the hands of the surgeon who will first carefully treat the baby and then skillfully treat the disease.

EDWARD J. DONOVAN

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service of Dr. R. Finochietto at the Hospital Rawson.

Each surgical paper deals with a case. The indications as to the type of operation are first discussed, and the selected procedure is given in full detail with numerous highly informative comments. The series will form an excellent source of information as to how surgery is practiced routinely by Dr. Finochietto and his resourceful coworkers.

*Páginas de cirugía*<sup>1</sup> is a 262-page book and is dedicated to Dr. E. Finochietto by the same workers mentioned previously in Dr. R. Finochietto's service. Fifteen different surgical procedures, including all types of surgery, are described. These works appeared in the *Prensa medica Argentina* (August 9, 1944) and are presented herein in a book form. F. F. REMY.

IT is impossible to review Cantor's *Ambulatory Proctology*<sup>2</sup> without being moved to comment on the author's viewpoint, highlighted as it is in title and preface. The author advocates and urges the performance of such procedures as extensive hemorrhoidectomy, repair of rectal prolapse and fistulectomy (to mention only three of many operations listed) on an office ambulatory basis. This attitude of mind which takes cognizance of the mechanical and physical equipment of the doctor's office, rather than the hazard to the patient, is unsurgical, unscientific, and dangerous to say the least. The practitioner would do well to pause and think of his patient before embracing such frankly dangerous practice.

If one does not take too seriously the author's mode of practice, the material encompassed in this volume is commendable. The discussion of the various proctologic ailments, though limited chiefly to management, is well presented. Steps to be taken in treatment are listed in definite sequence. There is a good section on pediatric proctology, which is missing in most recent books on the subject. Too great emphasis is placed on "tattoo" technique or what the author refers to as "tattoo neurotomy" in the treatment of pruritis ani, a method by no means applicable to a very large percentage of cases and certainly not available or practical for the average doctor.

There are many good illustrations. Especially well done are those descriptive of fistula in ano and fistulectomy.

One half of the book is devoted to medical diseases of the rectum and colon. Each chapter is concluded with an up-to-date and extensive bibliography.

THOMAS J. MURAR.

THE book *Surgical Treatment of the Nervous System*<sup>3</sup> edited by Bancroft and Pilcher is very sat-

isfactory, for it is simple; the descriptions are brief but adequate; and the twenty chapters have been contributed by seventeen different authors, so that there is considerable diversity. The plain truth is that neurosurgery, though a young and specialized field, does not lend itself well to an entire volume by a single author, for already among neurosurgeons themselves, there is some tendency to specialization or, at least, their talents and interests lie in different directions. Thus, one clinic may see large numbers of protruded discs, another, many sympathectomies, and still another may largely occupy its time with tumor surgery. And no civilian neurosurgeon can hope to match the sophistication of the younger men with army experience, with respect to peripheral nerves and cranioplasty.

Dr. Pilcher has picked leaders in all the fields he has covered. Their attacks on the subjects assigned to them have been orthodox and sound. While the book is perfectly understandable to the beginning student in the field, it is also of interest to the most experienced. It is reasonably well illustrated, and this reviewer found it as competent a book as exists on neurosurgery. ERIC OLBORG.

THE book *Modern Management in Clinical Medicine*<sup>4</sup> by F. Kenneth Albrecht is quite different from any of the usual textbooks of medicine, and is also different from the usual compendium of therapy. It attempts, and in great part succeeds, in being a handbook of the practice of medicine. It has an excellent professional attitude. Emphasis is placed upon the importance of a good case history as a basis for diagnosis, and each section contains a very complete printed case history form directed to the development of the histories typical of each system being studied.

The second chapter covers nutrition and vitamin deficiency diseases. It is brief, but complete and well illustrated. The unit standardization of all clinically available vitamins is given. As is true throughout the book, one might differ with particular stunts in treatment that appeal to the author, such as the use of benzedrine in the management of obesity.

The next chapter is on disorders of the digestive tract. Valuable and demonstrative x-ray pictures are reproduced, showing all important organic pathology of the gastrointestinal tract. Anorectal conditions are not neglected. This attention to such common aggravating, minor clinical conditions that make up such an important part of office practice is characteristic of this work, and will go far to make it of great usefulness.

The next main section of the book is on diseases of the blood and blood-forming organs by Dr. Seward E. Miller, Surgeon, U.S. Public Health Service, Chief of the Department of Pathology, U.S. Marine Hospital, Baltimore. This opens with a good modern discussion of various analyses in hemocytometry.

<sup>4</sup>MODERN MANAGEMENT IN CLINICAL MEDICINE. By F. Kenneth Albrecht, M.D. Baltimore. The Williams & Wilkins Co., 1946

<sup>1</sup>PÁGINAS DE CIRUGÍA. By Enrique Finochietto. Buenos Aires. La Prensa Medica Argentina, 1945.

<sup>2</sup>AMBULATORY PROCTOLOGY. By Alfred J. Cantor, M.D. With a foreword by Beaumont S. Cornell, M.D. New York and London: Paul B. Hoeber, Inc., 1946.

<sup>3</sup>SURGICAL TREATMENT OF THE NERVOUS SYSTEM. Edited by Frederic W. Bancroft, A.B., M.D., F.A.C.S. and Cobb Pilcher, M.D., F.A.C.S. Philadelphia, London, Montreal: J. B. Lippincott, 1946.

tients in these large groups were operated upon by the Bassini method. The writer does not know of any statistical follow-up report for a series of cases done by techniques other than the Bassini (as previously defined) furnishing data to which these principles can be applied.

The traditional view of inguinal hernia has it that there are two types, indirect and direct, and that this hard-and-fast compartmentation is maintained throughout the life of the hernia. It notes the increasing frequency of direct hernia with advancing age and muscular relaxation, considers diverticular hernia through Hesselbach's triangle to be rare and conceives the ratio of direct to indirect hernia as being about 1 to 5 in adult males. Those surgeons who, like the writer, believe the results of the Bassini repair to be worse than necessary, although we cannot yet prove that our preferred methods have given better, find much recently recorded evidence that the conception of inguinal hernia just outlined gives a very limited and, in some respects, a false view of the situation. The unusually comprehensive findings of Skinner and Duncan of the United States Public Health Service record that, of 1126 primary inguinal hernias, there were 426 with indirect sacs plus varying degrees of weakness, relaxation, or virtual absence of the posterior wall below the internal ring and 700 direct hernias, including 308 bilocular (i.e., combined) hernias; "few" patients were found to have simple, indirect sacs without enlargement of the aponeuroticofascial margins of the internal ring. Ramos and Burton of the Veterans' Administration, report that the majority of 457 primary inguinal hernias were bilocular. The significance of these findings as to the complexity of the "average" primary hernia in the adult male lies in the fact that their series are the only ones large enough to have statistical significance in which is reported routine exploration for secondary sacs, for thickness and state of tension of the posterior wall, and for the accurate estimation of the size of the internal ring by the introduction of a finger through the opened neck of the sac at the internal ring. This procedure was recommended by Hoguet in 1920, by Pitzman in

1921, and more recently by Fallis, Zimmerman, and Harkins, with whose views on the anatomical problems to be met the writer entirely concurs. The series of anatomical papers by Anson and McVay and their later collaborators, beginning in 1937, are unquestionably the most notable anatomical contribution to the subject of hernia to come from the dissecting room in many years. Their pertinent findings in a very large series of dissections are that the inguinal ligament does not receive insertions of the cremasteric portion of the internal oblique or of the transversus aponeurosis and that the inguinal ligament itself is attached only loosely in its midportion to the fascia lata of the thigh. They urged that since the normal insertion of the transversalis fascia is to Cooper's ligament along the superior ramus of the pubis, laxness of the lower portion of the posterior wall should be remedied by suture of the transversalis fascia (and such fibrous elements of the lowest portion of the internal oblique as might be present) not to the inguinal ligament, but to Cooper's ligament. They also point out that the so-called conjoined tendon of the internal oblique aponeurosis and transversalis fascia is a very inconstant structure. The first clinical application of their findings was in the repair of direct hernia but their warning against the use of the inguinal ligament in any part of its course has been extended to the entire field of inguinal hernia repair.

Data on one further, very important technical aspect of the operative treatment of hernia are those furnished by Parsons which present the results of two comparable series of hernias operated on during the same period by the same group, the only difference in technique being that fine silk was used for ligatures and sutures in one series, catgut (size and characteristics unknown) in another. In 458 operations for inguinal hernias of all types in which silk was employed, the recurrence rate was 3.5 per cent; in 244 operations utilizing catgut, the rate of failures was 12.7 per cent. His figures can be tabulated to show that in the 91 cases most likely to failure of the silk series (combined, sliding and recurrent hernias) the recurrence rate was less than 8 per cent in each category, whereas of 49

The actual commercial extracts of liver are listed, with their U.S.P. units.

The chapter on cardiology is extensive and includes a simple and useful discussion of electrocardiography. It is interesting that the use of testosterone propionate in the treatment of angina pectoris is recommended. There is a good chapter on peripheral vascular disease. Buerger's exercises are well illustrated. The treatment of varicose veins by injection is described in detail.

The discussion of diseases of the kidneys quotes completely and verbatim the excellent instructions of Dr. George Thorn for the management of various types of renal insufficiency. As one might expect from the U.S. Public Health Service, the diagnosis and management of venereal diseases has a long, very well illustrated and excellently detailed account. The colored illustrations of skin lesions are excellent.

The chapter on diseases of the respiratory system emphasizes physical findings, but also has an abundance of excellent x-ray reproductions. Pneumothorax treatment of tuberculosis is described in detail.

The chapter on arthritis, as usual, opens with an arthritis case history form. The treatment of rheumatoid arthritis is divided in an interesting manner into those measures of proved value, those which have had optimistic recommendations but of which the value is still undetermined or inconclusive, and those which are of questionable value or are useless.

The section on endocrinology for the general practitioner is of excellent practical value. The discussion of the management of diabetes is simple, very practical, and correct. In this field one might again differ as to a particular procedure, such as the permission to allow excessive thyroid dosage in the treatment of any case of myxedema; for instance, "2 grains three times daily for five days"; or to state "the treatment of myxedema is aimed at elevating the basal metabolic rate." The use of thiouracil is discussed, but the dangers of its administration are not sufficiently stressed. More emphasis in this chapter should be placed upon the treatment of the menopause. A useful table of commercial endocrine products with the trade name, the chemical name and the standardization of dosage is given.

The section on allergy is good. It contains a pollen table arranged according to months and states throughout the United States, and directions for desensitization management.

Dr. Miller contributes a useful chapter on toxicology, with a table of a great many poisons with their antidotes.

The infectious diseases are covered with the use of excellent illustrations, and a full discussion of the newest chemotherapeutic agents.

Tropical diseases of post war importance receive for the first time in an American textbook of medicine an adequate, thoroughly illustrated chapter.

There is a long section, as is deserving, on nervous and mental diseases, which opens with the state-

ment: "The idea that the diagnosis of organic disease of the nervous system can be made only by those specializing in neurophysiology, neuroanatomy and neuropathology is too generally accepted by many intelligent practitioners." The use of the well illustrated and complete section which follows should go a long way to change this conception. Mental disorders are approached in an objective manner with an excellent outline of a "neuropsychiatric and psychosomatic case history record." Practical methods of psychiatric examination and modern methods of treatment are then discussed. It is a pleasure to find a practice of medicine including such a useful treatise on the practice of neuropsychiatry.

Again, as one would expect from the U. S. Public Health Service, the diagnosis and treatment of common skin disorders is given full and useful representation.

Chemotherapy and antibiotic therapy are covered in Chapter 18. In harmony with the changing practice of medicine, geriatrics, the care of the aged, receives a chapter of its own. A chapter containing many useful hints for the general practitioner in his important duty of managing the patient at home rather than in the hospital is covered in a chapter labeled "The Care of the Ambulatory Patient."

Finally Dr. Miller adds a short compact chapter on clinical laboratory methods, including that *bête noir* of the general practitioner, the listing of chemical values in milliequivalents per liter rather than in milligrams per 100 cubic centimeter. Not satisfied with such complete coverage, the author adds an appendix covering directions for the performance of many "common procedures," such as thoracentesis, pericardial and abdominal paracentesis, blood typing, and blood transfusion, hydrotherapy, genitourinary treatment, and a list of practical diet menus.

Each of the twenty-one chapters and appendix is followed by a short, but authoritative list of modern references.

In summary one may say that the internist and general practitioner will find this a very helpful and useful work.

PAUL STARR.

The small volume *Motor Disorders in Nervous Diseases* by Ernst Herz<sup>1</sup> was first prepared as a syllabus to be used together with a collection of teaching motion picture films on the general subject of neurology. Alone, with the many good illustrations furnished, it is actually a descriptive atlas dealing with the testing of motor function and the commoner forms of the pathology of motion.

This book should be a valuable aid to students who are struggling to apply their usual maze of anatomical and physiological facts to the study of actual disease states in patients, since both the illustrations, some of which are good diagrams, and the straightforward and uncomplicated text put the disorders of motor function on a practical, physiological basis. It is pointed out that a large part of any

<sup>1</sup> MOTOR DISORDERS IN NERVOUS DISEASES. By Ernst Herz, M.D., and Tracy J. Putnam, M.D. New York: King's Crown Press, 1944.

complete neurological examination is concerned with a study of the motor function, and the book proceeds according to a plan which the authors believe to be a logical approach in clinical diagnosis. The common reflexes are shown in photograph form. Such terms as *apraxia*, *dystonia*, and *tic* are illustrated by excellent figures and described in simple, brief, understandable text. Almost half the book is concerned with the motor disorders of the cranial nerves, by no means a disproportionate amount of space for that part of neurological study which is so often confusing to the beginner.

This is not an exhaustive treatise. Its primary purpose is that of use with prepared motion pictures. Nevertheless it is, alone, a book that will be found useful to students and teachers alike. Perhaps the authors will decide to publish a companion text on sensory dysfunction and other special phases of neurological examination.

The book is published by the King's Crown Press, "a division of Columbia University Press organized for the purpose of making certain scholarly material available at minimum cost." The modest price of the book is three dollars. JOHN MARTIN.

## BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

**DEMONSTRATIONS OF OPERATIVE SURGERY FOR NURSES.** By Hamilton Bailey, F.R.C.S. Baltimore. Williams & Wilkins, 1945.

**SYNOPSIS OF OBSTETRICS AND GYNAECOLOGY.** By Aleck W. Bourne. 9th rev. ed. Baltimore. Williams & Wilkins Co., 1945.

**PNEUMOPERITONEUM TREATMENT.** By Andrew Ladislaus Banyai, M.D., F.A.C.P., F.C.C.P. St Louis: The C. V. Mosby Co., 1946.

**A TEXTBOOK OF GYNECOLOGY.** By Arthur Hale Curtis, M.D. 5th ed. Philadelphia and London. W. B. Saunders Co., 1945.

**AUTOPSY DIAGNOSIS AND TECHNIC.** By Otto Saphir, M.D. With a Foreword by Ludwig Hektoen, M.D. 2d rev. ed. New York, London: Paul B. Hoeber, Inc., 1946.

**THE RESULTS OF RADIUM AND X-RAY THERAPY IN MALIGNANT DISEASE.** 2d Statistical Report from The Holt Radium Institute, Manchester, 1934-1938. Edinburgh: E. & S. Livingstone, Ltd., 1945.

**BABY: A MOTHER'S MANUAL.** By Stella B. Applebaum. With introductions by Bela Schick, M.D., and Margaret E. Fries, M.D. Chicago, New York: Ziff Davis Publishing Co., 1946.

**DIAGNÓSTICO Y TRATAMIENTO DE LAS VARICES ESPECIALES.** By J. Valla-Serra. Barcelona: Librería de Ciencias Médicas, 1945.

**THE MODERN TREATMENT OF DIABETES MELLITUS.** By William S. Collins, B.S., M.D., and Louis C. Boas, A.B., M.D. Springfield: Charles C. Thomas, 1946.

**SPEZIELLE CHIRURGISCHE THERAPIE.** By Dr. Max Saegesser. Bern: Hans Huber, 1945.

**DISEASES OF THE RETINA.** By Herman Elwyn, M.D. Philadelphia, Toronto: The Blakiston Co., 1946.

**HUMAN TORULOSIS.** By Leonard B. Cox, M.D., M.R.C.P., F.R.A.C.P., and Jean C. Tolhurst, M.Sc. Melbourne: Melbourne University Press, 1946.

**ANESTHESIA IN GENERAL PRACTICE.** By Stuart C. Cullen, M.D. Chicago: The Year Book Publishers, Inc., 1946.

**MEDICAL EDUCATION AND THE CHANGING ORDER.** By Raymond B. Allen, M.D., Ph.D. New York: The Commonwealth Fund, 1946.

**LA MÉTHODE DU LEVER PRÉCOCÉ EN CHIRURGIE ABDOMINALE.** By André Chailier. Paris: Masson et Cie, Editeurs, 1945.

**WOMEN IN INDUSTRY; THEIR HEALTH AND EFFICIENCY.** Issued Under the Auspices of the Division of Medical Sciences and the Division of Engineering and Industrial Research of the National Research Council. By Anna M. Beatjer, Sc.D. Philadelphia and London: W. B. Saunders Co., 1946.

# CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

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*Committee on Arrangements*

HOWARD A. PATTERSON, *Chairman*; FRANK GLENN, *Secretary*

## CLINICAL CONGRESS IN NEW YORK POSTPONED BECAUSE OF UNITED NATIONS ASSEMBLY

THE UNITED NATIONS GENERAL ASSEMBLY WHICH WILL BE HELD IN NEW YORK THIS SEPTEMBER HAS MADE IT NECESSARY TO POSTPONE UNTIL 1947 THE LOCAL FEATURES OF THE FOLLOWING PROPOSED PROGRAM IN NEW YORK. THE MATERIAL WAS READY FOR PUBLICATION WHEN IT BECAME NECESSARY TO CANCEL THE 1946 CLINICAL CONGRESS IN NEW YORK AND IT IS THEREFORE BEING PUBLISHED HEREWITH WITHOUT CHANGE. PLANS ARE NOW UNDER CONSIDERATION FOR A MEETING TO BE HELD THIS FALL IN ANOTHER CITY WHERE ADEQUATE ACCOMMODATIONS MIGHT BE AVAILABLE.

NINETY days after arrangements had been completed to hold the thirty-second annual Clinical Congress of the American College of Surgeons in New York from September 9 to 13, plans were announced for the United Nations Assembly in that city during the same month requiring hotel accommodations for around six to eight thousand people. Acting upon authoritative advice, the College at first proceeded with plans for the Congress, and the Committee on Arrangements in co-operation with the local hospitals drew up a most excellent clinical program which is published in succeeding pages. Later developments made it increasingly evident, however, that the Fellows would be put to so much discomfort and inconvenience, if indeed they were able to obtain hotel accommodations at all, that postponement of the Clinical Congress was imperative.

The decision to postpone the Congress was made with especial reluctance because of the fact that no later date this year seems to be available for the meeting in New York. Negotiations are in progress and it is hoped that announcement of a definite date can be made in the very near future. Because of the well advanced stage of the program for both the clinical and scientific sessions, and the superior facilities available in New York for the momentous event which the next Congress will be after so long a period without annual meetings, it is not considered desirable to move to another city unless absolutely necessary. There-

fore, work on the program in New York is proceeding, in accordance with the outline in the following pages.

### SIXTH NEW YORK CONGRESS

This will be the sixth time that the Clinical Congress has been held in New York. The first time was in 1912, when the old Waldorf-Astoria was the scene of the third Congress. Dr. George E. Brewer was the Chairman and Dr. Charles H. Peck the Secretary of the 1912 Committee on Arrangements. Dr. Edward Martin of Philadelphia was then President of the Clinical Congress of Surgeons of North America. More than 2,600 physicians registered, and the lack of organization for regulating the attendance at the clinics precipitated the proposal by Dr. Franklin H. Martin at the business meeting on Friday afternoon, November 15, for the creation of the college.

At the same meeting Dr. Allen B. Kanavel presented a resolution which provided that "some system of standardization of hospital equipment and hospital work should be developed, to the end that those institutions having the highest ideals may have proper recognition before the profession, and that those of inferior equipment and standards should be stimulated to raise the quality of their work. . . ." and that "the President of the Congress be authorized to appoint a committee from the profession, delegated to carry the spirit of this resolution into effect, and report at the Clinical Congress in 1913."

Another significant event was the appointment, during an evening session given to the consideration of cancer, held in Brooklyn, of a committee that formed the nucleus of the American Society for the Control of Cancer which was organized following the Congress of Physicians and Surgeons of North America on May 22, 1913.

Thus the plans for formation of the College and for the inauguration of activities in two fields which have always been among its major concerns, hospital betterment and cancer control, were initiated at the 1912 Clinical Congress in New York, 5 years before the Congress was amalgamated with the American College of Surgeons. Later Congresses were held in New York in 1919, 1924, 1931, and 1938.

#### FIRST POSTWAR CONGRESS

The first postwar Clinical Congress will differ from the meetings for several years prior to the war in that a return will be made to the original custom of holding the Presidential Meeting on the opening evening, Monday, and the Convocation on the final evening, Friday, instead of combining them on the first night. There are several good reasons for the change among which is the likelihood of having several hundred surgeons, who have been received into fellowship *in absentia* during the years in which no Convocation was held, added to the number of initiates for the current year who will be present for the initiation ceremonies. Related to this is the need for relieving the pressure for hotel accommodations by distributing the attendance better throughout the week than would be possible if the Convocation were held on the opening night.

#### COMMITTEE ON ARRANGEMENTS

A representative Committee on Arrangements has been appointed consisting of the following members:

Howard A. Patterson, <i>Chairman</i>	George J. Heuer
Frank Glenn, <i>Secretary</i>	J. William Hinton
Frank E. Adair	Virginius B. Hirst
Albert H. Aldridge	George H. Humphreys
Thomas M. Brennan	Robert H. Kennedy
E. Jefferson Browder	William F. MacFee
George F. Cahill	John H. Mulholland
Henry W. Cave	W. Barclay Parsons
Ralph Colp	Brittain F. Payne
Edward J. Donovan	Otto C. Pickhardt
Merrill N. Foote	Thomas H. Russell
John H. Garlock	Raymond P. Sullivan
Charles A. Gordon	Howard C. Taylor, Jr.
	William Crawford White
	Philip D. Wilson

The Committee has been working diligently for several weeks on plans for the meeting.

#### CLINICAL PROGRAM

The hospitals and medical schools of greater New York are co-operating in scheduling operative and nonoperative clinics, and group clinical conferences. Visiting surgeons will have ample opportunity to attend well arranged programs of many different kinds in several of the excellent hospitals in the area. General and special demonstrations will be held such as fractures, cancer, maternal morbidity, and end-result studies; clinicopathologic and x-ray conferences; newer diagnostic and therapeutic procedures; preoperative and postoperative supportive treatment; anesthesia; and reconditioning. The newer techniques and surgical procedures may be observed by those who are interested in them.

The medical schools will hold a series of exhibits demonstrating their work which will be on display in their affiliated hospitals. The program of each hospital will be arranged to cover subjects in general surgery, obstetrics and gynecology, fractures, orthopedic surgery, thoracic surgery, neurosurgery, genitourinary surgery, ophthalmology, and otolaryngology.

#### PRESIDENTIAL MEETING

On Monday evening in the Grand Ballroom of the Waldorf-Astoria, the Presidential Meeting will be opened with the impressive procession of the officers, regents, and honorary guests. Welcome to the assembly will be extended by the chairman of the Committee on Arrangements, Dr. Howard A. Patterson. Dr. W. Edward Gallie of Toronto, President of the College, will preside and will deliver the Presidential Address. An inaugural ceremony will be held for the incoming officers. Foreign guests will then be introduced.

A new feature to be included in the Presidential Meeting this year will be the first Martin Memorial Lecture. Dr. Edward D. Churchill of Boston has accepted the invitation to give this lecture. This lectureship was established upon motion of the Board of Regents at its midyear meeting on April 1, as a memorial to both Dr. Franklin H. Martin and Mrs. Martin. The founder of the College and of SURGERY, GYNECOLOGY AND OBSTETRICS was joined by his wife in making the College the beneficiary at their deaths of the Journal, together with its physical plant operated by the Surgical Publishing Company of Chicago, of which they were the owners. Doctor Martin died in 1935 and Mrs. Martin in 1945.

The Martin Memorial Lecture to be given annually during Clinical Congress, and dealing with a scientific subject of the author's choosing, will supplant the former Annual Oration in Surgery.



## CONVOCATION

It is planned this year, for various reasons, to depart from the custom of recent years of holding the Presidential Meeting and the Convocation on the same evening. The Convocation is therefore scheduled for Friday evening. An Assembly of Initiates will be held prior to the Convocation on Friday in order to instruct them in the Convocation procedure and other matters.

The Convocation will open with a processional of officers, regents, and governors. The President, Dr. Irvin Abell, will preside and will make the opening remarks, confer the honorary fellowships and present the candidates for fellowship. Following this ceremony, a speaker to be announced later will give the Fellowship Address.

## FORUMS ON FUNDAMENTAL SURGICAL PROBLEMS

The Forums on Fundamental Surgical Problems will be conducted on Tuesday, Wednesday, Thursday, and Friday mornings. Included in them will be brief reports of original clinical and experimental observations relating to the broad aspects of surgery and the surgical specialties. No prepared discussions of the reports are planned, but questions and comments will be invited. Especially keen interest is expected in these sessions this year because of the accumulation of the results of 5 years of work since the last Clinical Congress. Dr. Owen H. Wangersteen of Minneapolis, chairman of the committee which is planning the program, is working toward representation of as many as possible of the various university departments of surgery in this presentation of clinical and experimental research work.

The enlistment of the interest of young men who are doing original work, through the forums, is one of the most beneficial results of these sessions which are now considered to be an indispensable feature of every Clinical Congress.

## HOSPITAL CONFERENCE

Dr. W. Edward Gallie, President of the College, will address the opening session of the twenty-fifth annual Hospital Standardization Conference on Monday morning at 10 o'clock in the Grand Ballroom, and will preside at the meeting, which will be attended by surgeons and hospital representatives. Following Dr. Gallie's resumé of the Hospital Standardization program of the College, including plans for the future, there will be reports on the progress of the 1946 Hospital Standardization survey, final results of which, including the Approved Lists of hospitals, cancer clinics, and approved hospitals for graduate training in surgery, will be announced at the end of the

year, instead of at the Clinical Congress as was the practice in former years.

The remainder of the Monday morning session will be devoted to talks by medical and hospital authorities on advances in medicine and surgery as they affect the postwar hospital, with particular consideration of their relation to the Hospital Standardization program.

The afternoon conference on Monday will be concentrated upon current problems and the outlook for the future in nursing service. The Tuesday morning conference will have as its main subject personnel management, and the Tuesday afternoon session will be centered around personnel problems in specific fields such as dietary laboratory, medical records, medical social service, x-ray, physical and occupational therapy and other professional and semi-professional services. The discussions will emphasize the importance of scientific management techniques in assuring high quality service from personnel.

The Wednesday morning conference will have as its main theme the importance of assuring high standards of care to the community and all patients through providing in the general hospital facilities for all types of illness. The subject will be discussed from the standpoint of psychiatric, tuberculous, cancer, chronically ill, and convalescent patients. The Wednesday afternoon conference will center mainly around discussion of ways of improving co-operation between general hospitals and special hospitals in the care of all types of special patients.

The Thursday morning conference will revolve around the physical plant of the hospital and the importance of improvement and modernization in raising standards of care of the patient. New mechanical and technical developments will be presented. The afternoon conference will be devoted to the hospital as the health center of the community, with consideration of the effects of this concept upon hospital public relations and upon the progress of preventive medicine and public health.

An evening conference will be held at 7 o'clock on Tuesday. This will be devoted to discussion of the responsibilities of trustees, and members of governing boards will be especially invited to attend and to participate. A conference will be held on Wednesday evening also. This will be a round table conference on responsibilities of hospital administrators, and the preparation which is necessary to enable them to cope successfully with the wide range of administrative problems. The discussion of these problems will interest all hospital personnel.

## CLINICAL CONGRESS PROGRAM IN BRIEF

*Monday*

- 10:00 General Assembly for Surgeons and Hospital Representatives, Grand Ballroom  
 1:30-3:00 Panel Discussion, Empire Room  
 2:00 Clinics, Demonstrations and Clinical Group Conferences, Selected local hospitals  
 2:00 Hospital Conference, Sert Room  
 1:00 Surgical Film Exhibition (General), Grand Ballroom  
 3:30-5:00 Panel Discussion, Empire Room  
 8:00 Presidential Meeting, Grand Ballroom

*Tuesday*

- 9:00 Clinics, Demonstrations and Clinical Group Conferences, Selected local hospitals  
 10:00 Hospital Conference, Sert Room  
 9:30 Surgical Film Exhibition (Eye, Ear, Nose and Throat), Jensen Suite  
 9:30-12:00 Forum on Fundamental Surgical Problems, Grand Ballroom  
 10:00 Surgical Film Exhibition (General), Empire Room  
 11:00 Panel Discussions  
     Ophthalmology  
     Otorhinolaryngology  
 1:30-3:00 Panel Discussion, Grand Ballroom  
 2:00 Clinics, Demonstrations and Clinical Group Conferences, Selected local hospitals  
 2:00 Hospital Conference, Sert Room  
 2:00 Symposium on Fractures and Other Traumas  
 2:00 Surgical Film Exhibition (General), Empire Room  
 3:30-5:00 Panel Discussion, Grand Ballroom  
 7:00 Surgical Film Exhibition (Eye, Ear, Nose and Throat), Empire Room  
 7:00 Hospital Conference—Trustees, Sert Room  
 8:00 Scientific Session, General Surgery, Grand Ballroom  
 8:00 Scientific Session, Ophthalmology, Jensen Suite  
 8:00 Scientific Session, Otorhinolaryngology, Le Perroquet Suite

*Wednesday*

- 8:00 Meeting of Cancer Committee, Carpenter Foyer and Dining Room  
 9:00 Clinics, Demonstrations and Clinical Group Conferences, Selected Local Hospitals  
 9:30 Hospital Conference, Sert Room  
 9:30 Surgical Film Exhibition (Eye, Ear, Nose and Throat), Empire Room  
 9:30-12:00 Forum on Fundamental Surgical Problems, Grand Ballroom  
 10:00 Surgical Film Exhibition (General)  
     State and Provincial Committees:  
     Judiciary Committees  
     Executive Committees  
     Credentialed Committees and  
     Committees on Applicants } Empire Room  
 11:00 Panel Discussions  
     Ophthalmology  
     Otorhinolaryngology  
 12:00 Meeting of Board of Governors, Jensen Suite  
 1:30-3:00 Panel Discussion, Grand Ballroom  
 2:00 Clinics, Demonstrations and Clinical Group Conferences, Selected local hospitals  
 2:00 Symposium on Cancer, Empire Room  
 2:00 Surgical Film Exhibition (General)

- 2:30 Hospital Conference, Sert Room  
 3:30-5:00 Panel Discussion, Grand Ballroom  
 6:00 Vandyck Reunion Dinner, Le Perroquet Suite  
 7:00 Surgical Film Exhibition (Eye, Ear, Nose and Throat), Empire Room  
 7:30 Hospital Conference, Sert Room  
 8:00 Scientific Session, General Surgery, Grand Ballroom  
 8:00 Scientific Session (Eye, Ear, Nose and Throat), Empire Room

*Thursday*

- 9:00 Clinics, Demonstrations and Clinical Group Conferences, Selected local hospitals  
 9:30 Hospital Conference, Sert Room  
 9:30 Surgical Film Exhibition (Eye, Ear, Nose and Throat), Empire Room  
 9:30-12:00 Forum on Fundamental Surgical Problems, Grand Ballroom  
 10:00 Surgical Film Exhibition (General), Empire Room  
 11:00 Panel Discussions  
     Ophthalmology  
     Otorhinolaryngology  
 1:30 Adjourned Meeting, Governors, Grand Ballroom  
 1:45 Annual Meeting, Fellows, Grand Ballroom  
 2:00 Clinics, Demonstrations and Clinical Group Conferences, Selected local hospitals  
 2:00 Hospital Conference, Sert Room  
 3:00 Panel Discussion—Graduate Training in Surgery, Jensen Suite  
 3:30-5:00 Panel Discussion, Grand Ballroom  
 3:30 Surgical Film Exhibition (General), Empire Room  
 3:30 National and Regional Fracture Committees, Le Perroquet Suite  
 4:00 Committee on the Library, Room 4-J  
 7:00 Surgical Film Exhibition (Eye, Ear, Nose and Throat), Empire Room  
 8:00 Scientific Session, General Surgery, Grand Ballroom  
 8:00 Scientific Session, Ophthalmology, Empire Room  
 8:00 Scientific Session, Otorhinolaryngology, Sert Room

*Friday*

- 9:00 Clinics, Demonstrations and Clinical Group Conferences, Selected local hospitals  
 9:30 Surgical Film Exhibition (Eye, Ear, Nose and Throat), Empire Room  
 9:30-12:00 Forum on Fundamental Surgical Problems, Grand Ballroom  
 10:00 Surgical Film Exhibition (General), Empire Room  
 1:30-3:00 Panel Discussion, Surgery of the Stomach.  
 2:00 Clinics, Demonstrations and Clinical Group Conferences, Selected local hospitals  
 2:00-4:00 Panel Discussions  
     Obstetrics, Sert Room  
     Plastic Surgery, 4-U Blue Room  
     Neurological Surgery, Assembly Room M-N  
     Thoracic Surgery, Jensen Suite  
     Urology, Le Perroquet Suite  
     Orthopedic Surgery, Carpenter Foyer and Dining Room  
 2:00 Surgical Film Exhibition (General), Empire Room  
 3:30-5:00 Panel Discussion, Surgery of the Vascular System.  
 8:00 Convocation, Grand Ballroom

## ANNUAL MEETING OF FELLOWS

The annual meeting of the Governors and Fellows will be held on Thursday afternoon at 1:45. There will be election of officers and governors. The annual meeting affords the Fellows of the College an opportunity to hear reports of officials on the work of the organization, and to learn how it has not only raised the professional and ethical standards of surgery, but has also promoted good hospitalization and general improvement in the practice of medicine in the United States and Canada. Each Fellow has a personal part in this work and may extend the influence of the College materially in his local community. Hospital Standardization alone offers him unlimited opportunity to provide better medical care for his patients in the hospital in which he works through continuous progress in applying the principles of the Minimum Standard which insure the best care of the patient.

Every Fellow will want to attend this important meeting, at which reports will be presented on financial affairs; Hospital Standardization; Graduate Training in Surgery; Medical Motion Pictures; Public Relations; Library and Literary Research; the work of the state and provincial credentials committees, committees on applicants, and the Committee on History Reviews; Sectional Meetings, 1946; and the Department of Clinical Research, including cancer clinics, medical service in industry, the Committee on Cancer, and the Committee on Fractures and other Traumas. Dr. Abell will report on administration of the College, staff changes, and retirements, and Dr. Arthur W. Allen, Vice-Chairman of the Board of Regents will discuss "Fellowships, Obligations and Opportunities."

STATE AND PROVINCIAL EXECUTIVE, CREDENTIALS  
AND JUDICIARY COMMITTEES

On Wednesday morning from 9:00 to 12:00 o'clock the State and Provincial Executive, Credentials, and Judiciary committees will meet to discuss their respective activities.

## MEDICAL MOTION PICTURES

The latest available films showing surgical procedures and related subjects will be shown in the medical motion picture exhibits which will be held daily. These are a much appreciated feature of the Clinical Congress. Despite the decrease in production of such films during the war period, a surprising number of new pictures on varied subjects are being received by the American College of Surgeons for review.

The schedule will be so arranged as not to conflict with either the clinical program at the hospitals or the scientific sessions. Both sound and silent, standard and color films will be shown, all of which have been approved by the Committee on Medical Motion Pictures.

## TECHNICAL AND SCIENTIFIC EXHIBITION

The technical exhibit, together with the registration and clinic ticket bureaux, will be located in the Basildon Room, Jade Room, and Astor Gallery, all on the third floor of the hotel. Leading manufacturers of surgical instruments, x-ray apparatus, sterilizers, operating room lights, ligatures, dressings, hospital apparatus and supplies of all kinds, pharmaceuticals, and publishers of medical books will be represented in the exhibition. The technical exhibits will demonstrate many of the newer features learned from our experience in the war.

## EVENING SCIENTIFIC SESSIONS

## GENERAL SURGERY

## Tuesday

*Care of the Patient before and after Operation*

Fluid and Electrolyte Balance. CARL MOYER, Eloise, Michigan.

Nutritional Preparation of the Substandard Risk Patient. RICHARD L. VARCO, Minneapolis.

Use of Blood and Blood Substitutes. JOHN D. STEWART, Buffalo.

Blood Transfusion Problems, with Special Reference to the Rh Factor. ALEXANDER S. WIENER, Brooklyn.

Safe Conduct of the Patient Through Operation. OWEN H. WANGENSTEIN, Minneapolis.

## Wednesday

*Venous Thrombosis and Prevention of Pulmonary Embolism*

Interruption of Deep Veins. ARTHUR W. ALLEN, Boston.

Sympathetic Nerve Block. ALTON OCHSNER, New Orleans.

Anticoagulants. D. W. GORDON MURRAY, Toronto.

*Fracture Oration*

Modern Methods in the Treatment of Fractures. EDWIN W. RYERSON, Chicago.

## Thursday

*Antibiotic and Chemotherapeutic Agents in Surgery*

Pathologic Physiology of Surgical Infections. JOHN S. LOCKWOOD, New Haven.

Penicillin—Its Use in Surgery and Influence on Earlier Types of Chemotherapy. WILLIAM A. ALTMAYER, Cincinnati.

Streptomycin. HORTON C. HINSHAW, Rochester.

Correlation of the Use of Antibiotic and Chemotherapeutic Agents with General Principles of Surgery.

CHAMP LYONS, New Orleans.

## OPHTHALMOLOGY

## Tuesday

*Orbital Reconstruction Including Prosthesis*

Acrylic Prosthesis.

Basket Implant. NORMAN L. CUTLER, Wilmington.

Orbital Measurements.

Reconstruction of Upper Lid and Orbital Floor Defects. Major ARTHUR E. SHERMAN, Springfield, Missouri.

## Thursday

Surgical Applied Anatomy in Eye Surgery. MEYER WIENER, Coronado.

Treatment of Glaucoma with Di-Isopropyl Fluorophosphate. PHILLIP ROBB McDONALD, Philadelphia.

Visual Disturbances Associated with Head Injuries.

## OTORHINOLARYNGOLOGY

## Tuesday

*Treatment of Deafness*

The Suppurating Ear.

The Fenestration Operation. GEORGE E. SHAMBAUGH, JR., Chicago.

Use of Radium for Conductive Deafness. JOHN E. BORDLEY, Baltimore.

## Thursday

*Surgery of the Nasal Accessory Sinuses*

Indications for Surgery in the Light of the Use of Antibiotics.

Intranasal Surgery. JOHN J. SUEA, Memphis.

External Operations.

## SYMPOSIUM ON PLASTIC SURGERY OF THE HEAD AND NECK

*Wednesday 8 p.m.*

Cancellous Bone Grafts to the Jaw.

Repair of Nasal Defects with Free Composite Grafts of Skin and Cartilage from the Ear. JAMES B. BROWN, St. Louis.

Studies in the Anatomy and the Repair of Cleft Palate.

Preservation of Function Following Resections of Jaw Tumors.

## PANEL DISCUSSIONS

## GENERAL SURGERY

*Monday, 1:30-3:00 p.m.*

Rehabilitation of the Surgical Patient and Early Ambulation. Leader, HOWARD RUSK, New York.

*Monday, 3:30-5:00 p.m.*

The Treatment of Cancer of the Large Bowel. Leader, FREDERICK A. COLLIER, Ann Arbor.

*Tuesday, 1:30-3:00 p.m.*

Thiouracil in Thyroid Disease. Leader, FRANK LAHEY, Boston.

*Tuesday, 3:30-5:00 p.m.*

Recent Trends in the Management of Carcinoma of the Cervix. Leader, JOE VINCENT MEIGS, Boston.

*Wednesday, 1:30-3:00 p.m.*

Anesthesia. Leader, HENRY K. BEECHER, Boston.

*Wednesday, 3:30-5:00 p.m.*

Protein Metabolism in the Surgical Patient. Leader, ROBERT ELMAN, St. Louis.

*Thursday, 3:30-5:00 p.m.*

Spinal Cord Injuries. Leader, HOWARD C. NAFFZIGER, San Francisco.

*Friday, 1:30-3:00 p.m.*

Surgery of the Stomach. Leader, ROSCOE R. GRAHAM, Toronto.

*Friday, 3:30-5:00 p.m.*

Surgery of the Vascular System. Leader, DANIEL C. ELKIN, Atlanta, Georgia.

## SURGICAL SPECIALTIES

*Friday 2:00-5:00*

Orthopedic Surgery Panel. (Subject to be announced.) Leader, CARL E. BADGLEY, Ann Arbor.

Urology Panel. (Subject to be announced.) Leader, HERMAN L. KRETSCHMER, Chicago.

Plastic Surgery Panel. (Subject to be announced.) Leader, ROBERT H. IVY, Philadelphia.

Neurological Surgery Panel. (Subject to be announced.) Leader, FRANCIS C. GRANT, Philadelphia.

Obstetrics Panel. (Subject to be announced.) Leader, FREDERICK C. IRVING, Boston.

Thoracic Surgery Panel. (Subject to be announced.) Leader, RICHARD H. SWEET, Boston.

## OPHTHALMOLOGY

Panel discussions in the field of Ophthalmology are planned for Tuesday, Wednesday, and Thursday mornings at 11:00 o'clock, on the following subjects: Retinal Detachment; Glaucoma; Keratoplasty.

## OTORHINOLARYNGOLOGY

Panel discussions on subjects in the field of Otorhinolaryngology are planned for Tuesday, Wednesday and Thursday mornings at 11:00 o'clock on the following subjects, respectively: The Treatment of Ménière's Syndrome; Osteomyelitis of the Skull; Rehabilitation of War Deafness.

## SYMPOSIUM ON FRACTURES AND OTHER TRAUMAS

At 2:00 o'clock on Tuesday afternoon there will be held a symposium on Fractures and Other Traumas under the direction of Robert H. Kennedy of New York. This symposium will be devoted to a number of brief presentations by specialists in various fields concerning new or improved methods adopted during the war which are applicable to injury in civilian surgery. The aim is to give a rapid survey of worthwhile gains made during the war which may prove of lasting value in the field of trauma.

Among the fifteen or twenty short papers which are planned are the following:

Bone Grafts. GEORGE K. CARPENTER, Nashville.  
Spinal Cord Injuries. DAVID H. POER, Atlanta.

Injuries to the Rectum. EDMUND J. CROCE, Worcester.

Transportation of Fractures. WILLIAM J. STEWART, Columbia.

Replacement of Skin Defects. JAMES B. BROWN, St. Louis.

Fractures of the Carpal Scaphoid. MATHER CLEVELAND, New York.

Amputations. RUFUS H. ALDREDGE, New Orleans.

Training of Amputees. HENRY H. KESSLER, Newark.

Rehabilitation. Col. A. WILLIAM REGGIO, Washington.

Compound Fractures Treated with Penicillin and Delayed Primary Closure. OSCAR P. HAMPTON, Jr., St. Louis.

## SYMPOSIUM ON CANCER

A symposium on cancer is planned for Wednesday afternoon. The Cancer Committee of the College has done outstanding work in furthering the development of cancer clinics in hospitals and providing for the registration of cured cases of malignant disease in the cancer archives. The chairman of this com-

mittee will give a brief review of these activities of the College in opening the symposium.

Other subjects of practical interest are under consideration for inclusion in the program, which is being planned to interest surgeons, pathologists, and radiologists.

similar cases closed with catgut, the rate of failure was above 20 per cent for each group. Although there are objections to accepting Parson's figures as being truly indicative of the ultimate rates of failure (all were done by a modified Bassini technique), yet the superior performance of silk over catgut can be accepted without reservation in one respect and with considerable reservation in another. That the recurrence rate followed the rate of wound infection (with approximately a ratio of 1 to 3 in favor of silk) throughout all his cases is clear. But since the length of time in which confinement to bed after operation was enforced is not alluded to, the influence of this factor in wound healing of his cases is not known. It is notoriously true that wounds sutured with catgut, however fine, heal more slowly than when silk is employed and those of us who used fine catgut extensively in the past were quite aware that in wounds whose anatomic and physiologic characteristics made them liable to separation under stress, it was necessary to enforce recumbency for a longer period before a firm scar was obtained than would have been the case with silk. This is, in the view of the surgeon familiar with the processes of wound healing, elementary in the postoperative management of the patient whose wound is sutured only with catgut. No data on the occurrence of herniation through any operative incision having the characteristics described are complete without a clear statement of the duration of strict confinement to bed in a position of semirecumbency. This realization seems to be missing from much surgical thought today and will require emphasis in the current trend to early ambulation. Shelley (16, 17, 18) found that in 1110 repairs of primary indirect inguinal hernia without postoperative complications, in whom the postoperative hospital stay (not confinement to bed) was for the 11 to 15 days, customarily in that institution, recurrences occurred in 7 per cent of the patients. A group of 336 patients with similar operations were confined to the hospital for 16 days or more because it was feared that they might develop complications, yet in them there were only 4.5 per cent of failures! Only catgut was used in either series.

Let us enumerate and comment on those steps which the writer regards as being essential to the performance of a radical hernioplasty with the smallest risk of failure. It is to be understood that the posterior wall of the inguinal canal is not merely the portion of Hesselbach's triangle between the inferior margin of the internal ring and the pubis, but also extends upward along the medial and lateral margins of the internal ring to its uppermost aspect; in patients with indirect hernia, the ring is invariably enlarged beyond the accepted normal dimensions, once its aponeuroticofascial margins have been demonstrated. This has been the observation of the writer in over 160 personally operated upon inguinal hernias on Naval personnel, of whom almost all had an indirect factor so far as the sac is concerned.

There are three major objectives of operation: (1) exploration of the components of the hernia (the sac, its contents and the abdominal wall of the inguinal region); (2) excision of the sac, whatever its characteristics, and closure of the peritoneum; (3) such plastic revision of the abdominal wall as may be indicated (complete or limited). Performance of the following steps will facilitate the accomplishment of these objectives.

1. Mobilization of the cremaster from its uppermost insertions into the transversus abdominis at the lateral margin of the internal ring and from its origins in the internal oblique muscle about the superior and medial margins of the external ring. Excision of these highest fibers of the cremaster exposes the medial and lateral margins of the internal ring, defines the free margin of the internal oblique muscle which is then retracted superiorly to expose the entire cord bundle and indirect sac in their passage through the internal ring. Excision of this portion of the cremaster also reduces the size of the cord bundle in the portion of its length which is to be brought out of the internal ring in closure and assures fascia-to-fascia approximation of the margins of the transversus abdominis. An intact cremaster is the greatest obstacle to identification of the transversus abdominis (or to realization of its existence as a readily accessible structure) known to the writer.

## PRELIMINARY CLINICAL PROGRAM—NEW YORK

## BELLEVUE HOSPITAL

## Monday

## Anesthesia—2.

E. A. ROVENSTINE and staff. Dry clinic: Management of anesthesia for intrapleural surgery. Nerve block demonstrations: glossopharyngeal block for diagnosis; sympathetic block for phantom pain; paravertebral block for fracture of ribs; suprascapular block for shoulder pain; discussion of drugs and methods. Exhibit: A male moulage is utilized to demonstrate the landmarks for various nerve blocking procedures.

## Neurosurgery—2.

JOSEPH KING, WILFRED WINGEBACH, LAWRENCE POOL, HERBERT REIKERT. Operative clinics.

## Ophthalmology (time to be announced).

DANIEL B. KIRBY. Cataract surgery; ptosis and strabismus surgery.

ARNO E. TOWN. Cornea.

JAMES HOULAHAN. Glaucoma.

LOREN P. GUY. Lacrimal passages.

## Radiation therapy—2.

IRA I. KAPLAN, RIEVA ROSH, SIDNEY RUBENFELD. Dry clinic: Head and neck cases.

## Urology—2.

ROBERT HOTCHKISS and HOWARD JECK; JOHN W. DRAPER and JOSEPH REIKERT; GUSTAV HUMPHRIES and GEORGE SLAUGHTER; DEAN MAKOWSKI.

## Tuesday

## General surgery—Operative clinics—8.

JOHN H. MULHOLLAND, THOMAS J. GALVIN, VICTOR CARABBA, SAMUEL STANDARD, IRWIN E. SIRIS, JOHN A. LAWLER, H. M. WERTHEIM.

## Dry clinic—10.

SAMUEL STANDARD. Results of anterior resection for carcinoma of rectum.

JOHN A. LAWLER and ELAINE P. RALLI. Postoperative thyroid results.

HENRY DOUBILET. Pancreatic enzymes.

CO TUI. Protein metabolism.

WALLACE B. MURPHY. Management of static ulcers.

VICTOR CARABBA. Results of repair of body defects by free fascial grafts.

WALTER B. CRANDELL. Vagus nerve resection for ulcer of stomach and duodenum.

JOHN HALL. Acute arteritis of the appendix.

SIGMUND WILENS. Tissue reaction to talc.

## Fractures and other traumas—round table discussion—2.

Fracture dislocation of the surgical neck of the humerus. Fractures of the neck of the humerus. Fracture dislocations of the elbow. Plateau fracture of tibial condyles. Fracture dislocations of the ankle. CARNES WEEKS, HERBERT J. REIKERT, IRWIN E. SIRIS, KENNETH M. LEWIS.

## Obstetrics and gynecology: Operative clinic—8; Dry clinic—10.

MORTIMER D. SPEISER. Management of unengaged vertex in multiparae at full cervical dilatation.

IRVING PERLMUTTER. Indications for therapeutic abortion at Bellevue Hospital, 1935-1945.

HERBERT B. GUYER. Preclinical cancer of the cervix—case report of 7 year history.

EQUINN W. MUNNELL. Management of the delivery of the second of twins.

LOUISE M. DANTUANO. Staphylococcus bacteremia—three cases.

## Physical medicine—2.

GEORGE G. DEEVER. Demonstration and motion picture: Rehabilitation of spinal cord injuries. Discussion: Evaluation of extent of disability; methods of treatment for ambulation and self-care.

## Radiation therapy—2.

IRA I. KAPLAN, RIEVA ROSH, SIDNEY RUBENFELD. Dry clinic: Breast and miscellaneous cases.

## Wednesday

## General surgery: Operative clinics—8. Dry clinic—10.

FRANK B. BERRY and associates

PHILIP C. POTTER, CARNES WEEKS, ROBERT WYLLIE,

DWIGHT B. FISHWICK, JAMES BAGG, WALLACE W.

SHERIDAN, WALTER W. FISCHER, ROBERT B. HYATT,

WILLIAM HEROV, AARON HIMMELSTEIN.

## Chest service: Operative clinic—8. Dry clinic—2.

FRANK B. BERRY and associates

HERBERT C. MAIER, ADRIAN LAMBERT, JR., LAURENCE

MISCALL, CHARLES W. LESTER, WALTER B. CRANDELL.

## Thursday

## General surgery: Operative clinics—8. Dry clinic—10.

ARTHUR S. McQUILLAN. Thyroid disease.

J. WILLIAM HINTON. Stomach.

LESTER BREIDENBACH. Colon.

EDWARD V. DENNEEN. Gall bladder.

L. BREIDENBACH. End-results: stricture of rectum from lymphogranuloma venereum.

## Children's surgery: Operative clinics—2. Dry clinic—3:30.

PHILIP ALLEN. Hernia.

CHARLES LESTER. Chest Surgery.

## Dental surgery: Dry clinic—3:30.

LEO WINTER.

## Fractures and other traumas—8.

KENNETH M. LEWIS. Fracture of femur (neck).

## Orthopedic surgery: Operative clinics—2. Dry clinic—3:30.

JOHN McCauley and ARTHUR KRIDA.

## Friday

## General surgery: Operative clinics—8:30.

GUILFORD S. DUDLEY. Abdominoperineal resection for carcinoma of the rectosigmoid.

RUSSELL H. PATTERSON. Vascular operative clinic.

CRANSTON HOLMAN. Subtotal gastrectomy for peptic ulcer.

ERNEST W. LAMPE. Thoracolumbar sympathectomy.

## Dry clinic—10:30.

LAURENCE MISCALL. Unusual cardiopulmonary wounds. Report on the diagnosis and treatment.

DAVID LYALL and JOHN LUOMANEN. Richter's hernia—a report on 17 cases.

JOHN LUOMANEN and PRUDEN. Internal fixation of fractures of the neck of the femur.

RUSSELL H. PATTERSON. The rôle of venogram in vascular surgery with a report of some unusual cases.

SAMUEL W. MOORE. Peptic ulcer perforation—a report on a series.

HERBERT REIKERT. Gastrojejuno-colic fistula—a report of 7 cases.

## Otorhinolaryngology: Operative clinic—2. Dry clinic—3:30.



# SURGERY, GYNECOLOGY AND OBSTETRICS

JOSEPH D. KELLY and staff. Laryngeal surgery. Presentation of cases.

*Röntgenology Exhibition*  
Roentgen illustration of inflammatory and neoplastic lesions. LEWIS J. FRIEDMAN. Tuesday through Friday—2-4 P.M.

## BETH ISRAEL HOSPITAL

*Tuesday*  
ARTHUR J. BARSKY—9. Plastic surgery: Operations.  
SEYMOUR F. WILHELM and staff—2. Urology: Operations.

*Wednesday*  
SIDNEY W. GROSSE and staff—9. Neurosurgery: Operations.  
HENRY C. FALK and staff—9. Gynecology. Operative and dry clinic.  
PERCY KLINGENSTEIN and staff—2. Surgery: Operative and dry clinic.  
EDWIN G. LANGROCK and SAMUEL J. SCADRON and staffs: 2. Operative obstetrics.

*Thursday*  
Gynecology: Operative and dry clinic—9.  
ARTHUR S. W. TOUROFF—2. Chest surgery.

*Friday*  
IRVIN BALENSWEIG and staff—9. Orthopedics: Operative and dry clinic.  
SOLOMON G. HERSHEY and staff—9. Anesthesiology.  
EDWIN G. LANGROCK and SAMUEL J. SCADRON—2. Tumor clinic; obstetrical clinic.  
Pantopague myelography in diagnosis of herniated intervertebral disc.

## FLOWER AND FIFTH AVENUE HOSPITALS

*Monday*  
Neurosurgery—3.  
ISADORE MAX TARLOV. Technique of nerve suturing and grafting by plasma clot.  
THOMAS IRVING HOEN. End-results.

*Tuesday*  
Breast Surgery—9.  
HERBERT CLIFTON CHASE. Carcinoma of the breast; demonstrations and end-results.  
Tumor clinic—11.  
GEORGE THOMAS PACK, GEORGE HIGGINS and FRANK JAMES BORRELLI.  
Thoracic surgery—2.  
SAMUEL ALCOCK THOMPSON and staff. The results of surgical treatment of anginal disease.

*Obstetrics—2.*  
HORACE ERNEST AYERS, L. S. LOUISEUX and staff. Demonstration on the Ayers mannequin; moving picture with sound and color.  
Orthopedics and fractures—2.  
MILTON JOHN WILSON, ALAN CANTWELL and staff. Fracture treatment with motion pictures and end-results demonstrations.

## Wednesday

JEROME GEORGE KAUFMAN, C. HENRY MERSHEIMER, and THOMAS H. MCGAVACK—9. Surgery of the thyroid and the use of Thyreua preparations.  
LANGE and JOHN S. O. HERRLIX, Jr.—11. The test of viability of the bowel by the fluorescein method.  
JOHN FOLENER FORD and DAVID MCCULLAGH MAYER—2. Dry clinic showing the methods employed in reconstruction of the external ear.

Ophthalmology—2.  
JOHN MILTON MCLEAN. Demonstration of the Ba-roquer phaco-erysis operation for cataract.  
CHARLES AARON TURTZ and CARL CONRAD SALKOW. Squint operation.

## Thursday

JOSEPH H. FORBES, JOHN CLIFFORD HAYNER and ALVA GRAHAM—9. Hernia; a new operation for hernia end-results; discussion of wound healing.  
—10:30. Femoral vein ligation for phlebostromosis, femoral vein ligation for chronic thrombophlebitis, femoral vein ligation for arteriosclerosis, thrombectomy, and embolectomy—indications and end-results.  
Plastic surgery—2.  
CLARENCE RALPH STRAATSMAN. Plastic surgery in otitis practice; operative and dry clinics.  
J. A. W. HETRICK and ARTHUR J. HERSIC. End results of tonsillectomy.

## Friday

JOHN S. HERBLIN—9. Accidents to the common duct. Indications for common duct surgery and methods for reconstruction.  
FRANCIS DAVIS SPEER—10. Water balance.  
JOHN S. HERBLIN—10. Surgical aspects of water balance.  
CHARLES A. HALBERSTAM and MICHAEL GEORGE MERO—11. A new amino acid preparation; its clinical use.

## GOLDWATER MEMORIAL HOSPITAL THE THIRD SURGICAL (N.Y.U.) DIVISION

*Monday through Wednesday (time to be announced)*  
WILLIAM H. BARBER, HAROLD B. KEYES and staff. C. ulcerative colitis.  
WILLIAM H. WALKER and staff. Non union and contractures.  
GEORGE W. SLAUGHTER and staff. Genitourinary problems in the aged.  
MARGARET STANLEY-BROWN, NED SHAYVERSON and staff. Peripheral vascular disease.

## HARLEM HOSPITAL

### Monday

Burns and plastic surgery symposium—2.  
JOSEPH A. TAMERIN. Resurfacing of extensive burn Clinical cases and lantern slides.  
ARTHUR L. GARNES. The problem of shock in burn.  
Gastric and biliary surgery symposium—3:15.  
AUBRE D. MAYNARD. Problems in biliary surgery.  
JOHN P. BRUCKNER. Gastric surgery.  
FRANCIS X. TIMONEY. Use of sulfonamides in peptic ulcer.

### Tuesday

Trauma symposium—9.  
RALPH H. YOUNG. Ward rounds—male building, followed by discussion of basic principles of traumatic surgery and nontraumatic surgery.  
DAVID H. SMITH. Head injuries: Presentation of cases stab wounds and functional tests.  
AARON PRIGOT. Injuries of liver, traumatic rupture, stab wounds and functional tests.  
ROBERT S. WILKINSON. Stab and gunshot wounds of abdomen.  
MYRA A. LOGAN. Stab wounds of the heart.  
Roentgenology in surgery—2.  
WILLIAM SNOW. Duodenal loop triad.  
LEON GINZBURG. Intestinal obstruction and regional ileitis.

Genitourinary conference—3:30.

NORMAN F. LASKEY and staff. Kidney and bladder trauma with presentation of cases; urethral stricture; renal calculi.

### Wednesday

FRANCIS X. TIMONEY. Ward rounds, Woman's building. Traumatic and nontraumatic cases.

LOUIS T. WRIGHT and JOSEPH LEVY. The problem of rectal stricture; presentation of cases.

BENJAMIN N. BERG. Pancreatic disease.

Gynecological symposium—2.

HENRY C. FALK and staff. Operative clinic in gynecological surgery; dry clinic: pelvic inflammatory disease.

### Thursday

Fracture and orthopedic symposium—9.

ARTHUR C. LOGAN, WILLIAM A. FREEMAN, ANTHONY T. PRIVITERA. Fractures of the femur, with demonstrations and correlated operations.

JOSEPH G. WISNER and staff. Slipped epiphysis with clinical demonstration.

SAMUEL SHENKMAN. Treatment of cervical spine with fracture.

LOUIS T. WRIGHT. Traumatic ward rounds.

Obstetrical symposium—2.

FREDERICK A. KASSEBOHN. Obstetrical emergencies and their treatment.

ABRAHAM C. POSNER. Recent advances in the toxemia of pregnancies.

JULIUS KURZROCK. The technique of Barton's forceps.

M. SCHREIBER. Analgesia in obstetrics.

NORMAN P. PLESSETTE. Tumors complicating pregnancy and labor.

WILLIAM SNOW. Soft tissue diagnosis by x-ray in obstetrics.

### Friday

Thyroid disease—9.

ALEXANDER ALTSCHUL. Medical aspects of thyroid disease.

JESSE J. GREENE. Surgical aspects of thyroid disease. Symposium on chest diseases—9:30.

JAMES C. WHITAKER. Injuries of the chest.

FARROW R. ALLEN. Thoracoplasty.

COSTABILE DI LORENZO. Surgical diseases of the chest.

DOMINICK F. ZETENA—10:10. Pediatric surgery.

ANGELO A. ZINGARO—11. Diverticulitis.

JAMES L. WILSON and ROBERT L. NACH—11:30. Amputation and the use of refrigeration anesthesia.

ANTHONY T. PRIVITERA—9. Traumatic ward rounds.

LOUIS T. WRIGHT—2. Mortality conference.

SOLOMON WEINTRAUB—2. Surgical pathology demonstrations.

The staff—2. Unusual cases.

## HARLEM EYE AND EAR HOSPITAL

### Wednesday

Otorhinolaryngology—1. Operations—Tonsillectomies with Meding tonsil enucleator.

Ophthalmology—2. Cataract extraction—Caldwell Luc.

Otorhinolaryngology—3. Demonstration of ear, nose and throat cases.

## HOSPITAL FOR JOINT DISEASES

### Monday

LEO MAYER and staff—8. Operative clinic. Tendon transplantation on the foot for traumatic division of flexor tendons; tendon transplantation in the hand for traumatic division of flexor tendons; fusion of the hip by new approach.

SAMUEL KLEINBERG and staff—2. Dry clinic. Demonstration of cases illustrating results of tendon transplants in the hand and foot and fusion operations on the hip: epiphysiolisthesis—results of drilling in early cases; chronic osteomyelitis—results of operation combined with use of penicillin; flat feet—indications for and results of Miller operation; club feet—manipulative and operative treatment; Perthes' disease.

### Tuesday

SAMUEL S. KLEINBERG and staff—8. Operative clinic. Spine fusion for chronic low back pain; herniation of intervertebral disc (A. KAPLAN); arthrotomy for internal derangement of the knee; epiphysiolisthesis—drilling; contracted toes—plastic operation; congenital dislocation of the hip—open reduction.

### Wednesday

ISADORE I. ZADEK—8. Orthopedic cases—operations: treatment of ununited fracture of hip. Obturator nerve avulsion for painful hip.

HARRY GOLDMAN—8. Operative clinic: Hemorrhoids; fistula-in-ano; benign adenoma of rectum.

PAUL WILLIAM ASCHNER—1:30. Operations on kidney and bladder.

HARRY DAVID SONNENSCHNEIN—2. Dry clinic orthopedic cases.

### Thursday

HARRY DAVID SONNENSCHNEIN and staff—8. Operations: arthrotomy of knee; lumbosacral fusion; transcervical plastic for radial nerve lesion.

HAROLD BERTRAM DAVIDSON and staff—1:30. Total hysterectomy for fibroids.

### Friday

ABRAHAM JACOB BELLER and staff—8. Operations for carcinoma of stomach and colon.

## HOSPITAL FOR SPECIAL SURGERY

### Tuesday

PHILIP DUNCAN WILSON and staff—9. Children's orthopedic problems.

LEWIS CLARKE WAGNER—9. Severe spondylolisthesis—case presentation.

General surgical operations—8:30.

### Wednesday

Children's orthopedic surgery—8:30.

CARL GOODWIN BURDICK and staff—9; 2. Hernia and special surgical problems.

Plastic surgery—9; 2.

YOLANDE E. H. HUBER and JOHN MARQUIS CONVERSE. Presentation of cases; motion pictures; plastic surgical operations.

### Thursday

Surgery of bones and joints—9; 2.

PHILIP DUNCAN WILSON and staff. Adult orthopedic problems.

LEWIS CLARKE WAGNER. Wedge osteotomy of neck of femur for badly displaced upper femoral epiphysis.

L. RAMSAY STRAUB. Spine fusion with plate fixation.

PHILIP DUNCAN WILSON. Trochanteric cup arthroplasty.

THEODORE C. THOMPSON; LEWIS CLARKE WAGNER. Restoration of active knee motion.

ROBERT LEE PATTERSON, JR. Conservative treatment of fractures of the tibial plateau.

WILLIAM MORRIS COOPER. Aseptic necrosis of the head of the femur in adults.

PETER RIZZO. Bone graft with metallic fixation.

JOHN J. FLANAGAN. Massive tibial bone grafts.

# SURGERY, GYNECOLOGY AND OBSTETRICS

*Friday*  
Surgery of bones and joints—8:30.  
RICHARD FREYBERG and staff. Arthritic problems.  
JOHN ROBERT COBB and staff—2. Scoliosis—idiopathic and paralytic.

## LENOX HILL HOSPITAL

*Monday*  
Obstetrics and gynecology—2.  
ROBERT MCCREADY and MORTIMER ROGERS. Total hysterectomy by combined vaginal and abdominal routes.  
EDWARD P. KILROE. Vaginal hysterectomy.  
CUNNINGHAM. Manchester-Fothergill operation.  
BOYNTON. LeFort operation.  
CARL GOLDMARK. Obstetrical analgesia—demerol versus barbiturates.

*Tuesday*  
Surgery—9.  
JOHN C. GERSTER, FRANCIS M. DONEHUE, HERBERT W. MEYER, ERIC FRICKE. Choice of operative procedures in lesions of colon and rectum.  
THORACIC SURGERY—2.  
C. EGGERS. Thoracic cases.  
HERBERT CAILLE MAIER. Results of lobectomy and pneumonectomy in bronchiectasis, cystic disease of the lung and pulmonary abscess.

*Wednesday*  
Surgery—9.  
OTTO CARL PICKHARDT. Treatment of hiatus hernia in older people by phrenophraxis.  
GEORGE ERNEST MUEHLER. Acute pancreatitis.  
HUBER. Symptomatology, diagnosis.  
BLAKE FERGUSON DONALDSON. Operative procedure.  
LEROY ALVIN WIRTILIN. End-results.  
Genitourinary surgery—2.  
WILLIAM ROBERT DELELL. Unusual calculi of urinary tract.

MAXIMILIAN MARK NEMSER. Polycystic kidney disease.  
SLAUGHTER. Treatment of rupture of urinary bladder.  
Ophthalmology—2.  
CHRISTIAN FREDERICK REID. Transplantation of mucous membrane for eye burns and keratitis.  
CHRISTIAN F. KETELS, JOHN HENRY BORN, RUDOLPH AEBLI, BERNARD FREAD, SAUER, ERNEST LUDWIG METZGER. Cataract surgery. Dry clinic postoperative: cases of retinal detachment.  
Ophthalmology clinic—2.  
RUDOLPH AEBLI and staff. Cataract operations; clinic on retinal detachments (demonstration of cases).

*Thursday*  
Diagnostic-Bronchoscopic clinic—9.  
ARTHUR JOSEPH CRACOVANER, HIRSCH. Bronchoscopy—indications and demonstration.  
HENRY PAUL SCHUCH. Tuberculosis of larynx; abscess of larynx.  
ERNEST ALFRED WEYMULLER. Aero-otitis and sinusitis—irradiation therapy.  
J. E. JOHNSTONE KING. Neurosurgery.  
Hematology and vascular surgery symposium—2.  
CARL REICH. Heparin and dicumaril.  
RICHARD WILLIAM KESSLER. Anatomy and operative procedures.  
ECHLIN. Neurosurgery procedures.

*Friday*  
McWILLIAMS. Venography.  
GEIGER. Rh factor and blood bank demonstration.  
Surgery of the bones and joints—9.  
WALTER ISAAC GALLAND. Osteotomy for osteoarthritis of hip.  
WALKER ELY SWIFT. Fracture—dislocation of ankle.  
ALFRED FRANZ WIESENTHAL. Hallux valgus—management and end-results.  
HENRY H. JORDAN. Roger Anderson pinning of fractures—end-results; hospital brace shop demonstration.  
MADGE C. L. MCGUINNESS. Discussion of general physical therapy procedures.  
FRED SQUER DUNN. Cleft palate.  
GUSTAVE AUFRICHT. Mammoplasty.

## LYING-IN HOSPITAL

*Monday*  
HENRICUS JOHANNES STANDER presiding—2. Presentation and discussion of interesting patients.

*Tuesday*  
BYRON HEAZELTON GOFF and JAMES AITKEN HARRAR. Operative clinic: Vaginal plastic operations; obstetrical operations.  
CHARLES MORDECAI McLANE. X-ray pelvimetry.  
JACOB THEODORE SHERMAN. The obstetrical pelvis from a clinical aspect.  
FREDERICK WALL FINN. Evaluation of myomectomies.  
JOHN T. COLE. Maternal obstetrical paralysis.

*Wednesday*  
ANDREW ANTHONY MARCHETTI. Ectopic pregnancy.  
CURTIS LESTER MENDELSON. Management of labor in cardiac disease.  
JOHN T. COLE and BRUCE WILLIAMS. Clinical application of our knowledge of Rh factor; a report of two transfusion deaths due to Rh incompatibility.  
ARTHUR VOSE GREELEY. Selective conservative management of endometriosis.

*Thursday*  
HENRICUS JOHANNES STANDER—9. Gynecology operative clinic.  
JAMES AITKEN HARRAR—9. Obstetrical operations.  
CHARLES MORDECAI McLANE—2. Sterility.  
ROBERT GORDON DOUGLAS—2. Rupture of the uterus.  
Experiences in the Lying-In Hospital since 1890.  
ROBERT GORDON DOUGLAS and R. LANDSMAN—2. Recent experience in the reduction of morbidity and puerperal infection in cesarean section.  
WILLIAM GIVEN—2. Carcinoma of the cervix.

*Friday*  
ANDREW ANTHONY MARCHETTI—9. Operative clinic.  
HOWARD SHEILD McCANDLISH—9. Obstetrical operations.  
JOHN T. COLE and FORBES DELANEY. Transverse presentation of vaginal smears.  
ANDREW ANTHONY MARCHETTI—2:30. Clinical significance of vaginal smears.  
CARL THEODORE JAVERT—2:30. Combined clinical procedure for anteroversion of retroverted uteri.  
WILBUR DIXON—2:30. Management of face presentation.  
FRANK SMITH—2:30. Missed abortion.

## MANHATTAN EYE, EAR AND THROAT HOSPITAL

*Monday*  
G. BONNOCCOLTO—2. Slit lamp demonstration.  
HERBERT MAURICE KATZIN—2. Demonstration comes grafting technique on rabbits.

CHARLES HUGH BRANIGAN—3. Demonstration of cases of cataract surgery complicated by glaucoma.

### Tuesday

WALTER GUERNSEY FREY—9. Surgical treatment of ptosis of lids; operation and end-results.

FRANK CONRAD KEIL—2. Surgical treatment of strabismus; operations and end-results.

FRANK CONRAD KEIL, JR. and MISS E. KNAUBER—2. Orthoptic clinic.

### Wednesday

ARTHUR LINKSZ—9. Demonstration of aniseikonia.

MURRAY A. LAST—9:30. Plastic operations of eye.

FERDINAND L. P. KOCH—9:30. Demonstration glaucoma clinic; late results of glaucoma surgery.

HERBERT MAURICE KATZIN—10. Demonstration of corneal grafting technique on rabbits.

RICHARD TOWNLEY PATON and HERBERT MAURICE KATZIN—2. Demonstration of corneal grafting technique; corneal research laboratory.

DAVID HENRY WEBSTER—2. Cataract surgery.

ANDREW ANDERSON EGGSTON and A. B. PAUL—2. Allergy in ophthalmology.

JOSEPH LAVAL—3. Eye pathology; demonstration microscopic sections.

### Thursday

G. BONNOCCOLOTO—9. Surgery; cataract extraction; corneal transplant; dacryocystorhinostomy.

FRANK CONRAD KEIL, JR.—10. Laboratory demonstration bacteriology of the eye.

RICHARD TOWNLEY PATON—2. Surgery; corneal graft.

MAURICE LENZ, CLARA LOWENHERZ OKRAINETZ—2. Radiation therapy in ophthalmology.

RICHARD TOWNLEY PATON—3. Demonstration of post-operative corneal graft cases.

### Friday

HERBERT MAURICE KATZIN—10. Demonstration corneal grafting technique on rabbits.

FRANK CONRAD KEIL, JR., and MISS E. KNAUBER—2. Orthoptic clinic.

### MANHATTAN EYE, EAR AND THROAT HOSPITAL OTOLARYNGOLOGY

### Monday

WILLIAM RICHARD CASHION. Biplane fluoroscopy and laminagraphy.

### Tuesday

WILLIAM BREWSTER ALLAN and ALFRED SCHATTNER—9. Nasal plastic operation.

MISS WHITEHURST and MRS. NERENBERG—9:30. Demonstration; audiometry; selection and fitting of hearing aids; retraining residual hearing.

DAVID SYLVESTER CUNNING—10. Demonstration of post-operative cases of laryngectomy; esophageal voice training.

DANIEL SYLVESTER CUNNING—2. Operation: laryngectomy.

ANDREW ANDERSON EGGSTON and DANIEL SYLVESTER CUNNING—3. Clinicopathological demonstration; malignancy of the larynx.

### Wednesday

MARVIN FISHER JONES—9. Fenestration: operation and demonstration of postoperative cases.

ANTHONY NIGRO—10. Operation for polypoid sinusitis and demonstration of postoperative cases.

DANIEL SYLVESTER CUNNING—1:30. Bronchoscopic clinic; diagnosis and treatment.

ANDREW ANDERSON EGGSTON and A. B. PAUL—2. Allergy in otorhinolaryngology; demonstration of cases and testing technique.

W. H. TURNLEY and G. S. RYAN—2. Tonsil surgery.

### Thursday

JOSEPH DOMINIC KELLY—10. Demonstration of results in cases of arytenoidectomy.

MAURICE LENZ and CLARA L. OKRAINETZ—2. Results of radiation in laryngeal tumors.

HENRY DAVID TATLREA—2. Demonstration of radiation of hypertrophied lymphoid tissue of nasopharynx.

MARVIN FISHER JONES—2. Operation: fenestration.

JOSEPH DOMINIC KELLY—2. Operation: arytenoidectomy.

### Friday

MISS WHITEHURST and MRS. NERENBERG—9:30. Demonstration; audiometry, selection and fitting of hearing aids; retraining residual hearing.

### MEMORIAL HOSPITAL

### Monday

Operative Clinics—8.

FRANK E. ADAIR and staff. Breast tumors.

GEORGE E. BINKLEY and staff. Rectal tumors.

BRADLEY L. COLEY and staff. Bone tumors.

HAYES E. MARTIN and staff. Intraoral tumors.

GEORGE T. PACK and staff. Gastric tumors.

CORNELIUS P. RHOADS—2. Steroid patterns in neoplastic diseases.

HAYES E. MARTIN—2:30. Late results in cancer of mouth and pharynx.

WILLIAM L. WATSON—3. Intrathoracic tumors.

FRANK W. FOOTE, JR. and LEO MARINELLI—3:30. Radio iodine in diseases of the thyroid.

F. HOMBURGER—4:30. Protein and carbohydrate metabolism in cancer cases.

### Tuesday

Operative clinics—8.

FRANK E. ADAIR and staff. Breast tumors.

HAYES E. MARTIN and staff. Intraoral tumors.

GEORGE T. PACK and staff. Gastric tumors.

HOWARD C. TAYLOR and staff. Gynecologic tumors.

WILLIAM L. WATSON and staff. Intrathoracic tumors.

HOWARD C. TAYLOR, JR.—2. End-results in cancer of cervix uteri.

FRANK WM. FOOTE, JR.—2:30. Early cancer of cervix uteri.

FRANK E. ADAIR—3:00. Hormone therapy in cases of advance mammary cancer.

FRED W. STEWART—3:30. Common errors in cancer diagnosis. Pathological aspects.

DAVIS KARNOFSKY and JOSEPH H. BURCHENAL—4:00. Use of nitrogen mustard in selected types of neoplastic disease.

### Wednesday

Operative clinics—8.

FRANK E. ADAIR and staff. Breast tumors.

GEORGE E. BINKLEY and staff. Rectal tumors.

BRADLEY L. COLEY and staff. Bone tumors.

HAYES E. MARTIN and staff. Intraoral tumors.

HOWARD C. TAYLOR and staff. Gynecologic tumors.

LYDD F. CRAVER—2. Late results in Hodgkin's disease.

GEORGE T. PACK—2:30. Transthoracic cardiotomy for gastric cancers.

GEORGE E. BINKLEY—3. Abdominoperineal resection.

DOUGLAS A. SUNDERLAND—3:30. Rectal lesions discovered in supposedly normal individuals in a cancer prevention clinic.

# **SURGERY, GYNECOLOGY AND OBSTETRICS**

**JULES C. ABELS—4:00.** Postoperative management of cases of gastrointestinal malignancies.

**Thursday**  
**ROBERT S. SHERMAN—10.** Round table roentgenographic conference.  
**HELEN Q. WOODARD—2.** Effect of radiation on normal and neoplastic bone.  
**BRADLEY L. COLEY—2:30.** Analysis of late results.  
**ARCHIE L. DEAN—3.** Treatment after bladder operations.  
**GEORGE T. PACK—3:30** End-results in malignant melanoma.

**SOPHIE SEITZ—4.** Infantile neuroanaevi—their confusion with malignant melanoma.

**Friday**  
**Operative clinics—8.**  
**FRANK E. ADAIR** and staff. Breast tumors.  
**HAYES E. MARTIN** and staff. Intraoral tumors.  
**GEORGE T. PACK** and staff. Mixed tumors.  
**HOWARD C. TAYLOR** and staff. Gynecologic tumors.

## **MONTEFIORE HOSPITAL**

**Tuesday**  
**SAMUEL SILBERT—2.** Mid-leg amputations for gangrene and paralytic diseases.

**Wednesday**  
**SYLVAN LEWIS HAAS—9.** Orthopedic surgery in arthritic and paralytic diseases.

**Thursday**  
**ISIDOR KROSS—2** Chest surgery—operative and dry clinic.

**Friday**  
**SAMUEL STANDARD—2.** Physiological derangements in organic disease of the intestinal tract—end-results of surgery.  
**ARTHUR HARVEY GLICK—2.** Errors in diagnosis in tumors of the large bowel.  
**DANIEL LASZLO—2.** Conference on neoplastic diseases and demonstration.

## **MOUNT SINAI HOSPITAL**

**Monday**  
**Gynecological clinic—8:30.**  
**MORRIS AARON GOLDBERGER.** Parametrial fixation operation (Fothergill).  
**MORRIS AARON GOLDBERGER.** Result of parametrial fixation operations; postoperative follow-up (ten years).  
**JOSEPH ARNOLD GAINES.** Conservative surgery for pelvic endometriosis.  
**EMANUEL KLEMPNER.** The value of the 24 hour pregnancy test: A review of 1,000 cases.  
**ARTHUR MAXWELL DAVIDS.** The clinical value of hysterography.  
**ROBERT ISADORE WALTER.** The management of the menopause.

**Neurological Surgery—2.**  
**ABRAHAM KAPLAN.** Long time follow-up in some neurosurgical cases (case presentations).  
**B. SCHLESINGER.** Correlation of x-ray findings and clinical picture.  
**IRA COHEN.** Dumbbell tumor of the spine.  
**S. GROSS.** Cranioplasty, motion picture demonstration

**Tuesday**  
**Surgery of the colon and rectum—8:30.** Operative clinic.  
**JOHN HARRY GARLOCK.** Anterior resection of the rectum; colectomy for ulcerative colitis.

**JOHN HARRY GARLOCK, LEON GINSBURG, SAMUEL HIRSH, OLD KLEIN, AMEIL GLASS, GABRIEL PARKIN, SELEY.** Dry clinic and case presentations.  
**Orthopedic clinic—2.**  
**ROBERT KORN LIPPMANN, ALBERT JACOB SCHEN, EDGAR MILTON BICK.** Operative and dry clinic.

**Wednesday**  
**Thoracic surgery—8:30.**  
**ARTHUR SIGMUND TOUROFF.** Operation for patent ductus arteriosus.  
**HAROLD NEUHOF.** Intramuscular heparin (concentrated) therapy in the prevention of postoperative thromboses and embolism.  
**Motion picture demonstration** Technique of operation for clotted hemothorax.  
**ARTHUR SIGMUND TOUROFF.** Results of operative treatment of traumatic thoracic lesions in civilian practice.  
**ERNEST EMANUEL ARNHEIM.** Operative results in peptic ulcer surgery.  
**EDWARD E. JEMERIN.** Results of surgical treatment of perforation of the esophagus.  
**IRVING ARTHUR SAROT.** Results of conservative surgical treatment of chronic pulmonary abscess.  
**Clinic on ophthalmology—2.**  
**DAVID LAMBERT, HENRY MINSKY, JOSEPH LAVAL, DAVID WEXLER.** The surgical treatment of glaucoma—operative clinic and dry clinic of operated cases.

**Thursday**  
**Surgery of the stomach and duodenum: Operative clinic—8:30**  
**RALPH COLP.** Supradiaphragmatic vagotomy for duodenal ulcer; subtotal gastrectomy and infradiaphragmatic vagotomy for duodenal ulcer with stenosis.

**Dry clinic**  
**FRANK HOLLANDER.** Physiologic differences between gastric and duodenal ulcers.  
**LEONARD DRUCKERMAN.** Palliative gastrectomy in selected cases of chronic gastric ulcer.  
**PERCY KLINGENSTEIN.** Problems in the treatment of gastrojejunocolic fistula.  
**SIGMUND MAGE.** Follow-up results in subtotal gastrectomy for gastric and duodenal ulcer.  
**STEPHEN ROSENAK.** The advantages of jejunostomy for jejunal alimentation.  
**Ear, nose and throat clinic—2.**  
**Inflammatory and neoplastic diseases of the frontal sinuses.**  
**Carcinoma of the larynx and results, treatment by radiation therapy.**  
**Operative and dry clinic.**  
**RUDOLPH KRAMER, MORRIS BENDER, IRVING BRICE, GOLDMAN, JOSEPH DRESS, SAMUEL ROSEN and staff**

**Friday**  
**Genitourinary surgery—8:30.** Operative clinic.  
**LEO EDELMAN.** Kidney operation.  
**GORDON DAVID OPPENHEIMER.** Carcinoma in a horse shoe kidney (dry clinic).  
**MOSES SWICK.** Bladder neck obstruction in young individuals.  
**WILLIAM MENCHER.** Perirenal insufflation.  
**H. EVANS LEITER.** Enuresis due to ectopic ureter.

## **METROPOLITAN HOSPITAL**

**Monday**  
**Neurosurgery—2.**  
**I. W. OLFENICK.**

## Tuesday

EDWARD J. McCABE, KENNETH C. PEACOCK and WILLIAM GREENWALD—9. Hemorrhage, perforation and the indications for surgery in peptic ulcer.  
 CHARLES A. HALBERSTAM, GEORGE HERLITZ and EUGENE FIERRO—11. Diagnosis and management of intestinal obstruction.

## Urology—2.

ALFRED HUNT and LEONARD P. WERSHUB. Total perineal prostatectomy.  
 GEORGE R. NAGAMATSU. Plastic operations for ureteropelvic junction obstruction.  
 SPRAGUE CARLETON. General discussion.

## Wednesday

HAROLD E. CLARK, WALTER GRAY CRUMP and WALTER L. MERSHEIMER—9. Colon surgery; Indications, methods and end-results.  
 H. B. SAFFORD and JOHN E. TRITSCH—10. Gynecology staff with presentation and consideration of problem cases.

## Thoracic surgery—2.

SAMUEL A. THOMPSON and staff. Value of cavernostomy in tuberculosis.

## Thursday

STEPHEN CHILIAN, LOUIS M. PALERMO and WILLIAM L. PRIMACOVE—9. Echinococcus cyst; diagnosis and management.

LOUIS R. KAUFMAN, LINN J. BOYD and CHRISMAN G. SCHERF—10. Surgery of hypertension; indications, technique and end-results.

JOHN F. FORD and DAVID M. MAYER—10. The problem in skin grafting for thrombophlebitis.

HARRY BAROWSKY—11. Round table discussion of abdominal diagnosis; gastroscopy.

LEONARD P. WERSHUB—11. Perinealoscopia.

JOHN HERRLIN and staff—11. Peritoneal tap and x-ray diagnosis.

MILTON JOHN WILSON and staff—2. Demonstration of end-results in spine and hip injuries.

## Friday

SAMUEL THOMAS GLASSER, JOSEPH A. SILEO, and G. ADLER—9. Peripheral vascular diseases: end-results in refrigerating anesthesia; amputation; lumbar sympathectomy; multiple nerve section; lumbar ganglion block; intra-arterial penicillin.

SAFFORD and JOHN E. TRITSCH—10. Gynecology staff with presentation and consideration of problem cases.

JOHN F. FORD and DAVID M. MAYER—10. The problem in skin grafting for thrombophlebitis.

K. LANGE, LINN J. BOYD, DAVID O. WEINER, and ALBERT LESSER—10:30. Frostbite, its physiology and morphologic pathology and the prevention of subsequent gangrene.

NEW YORK EYE AND EAR INFIRMARY  
OTOLARYNGOLOGY

Demonstrations and lectures daily by EARL FREDERICK LIMBACH, MAXWELL DONNELL RYAN, JAMES MORRISSET SMITH, JAMES SWIFT HANLEY, STUART LESSLEY CRAIG.

## OPHTHALMOLOGY

Demonstrations and lectures daily by WENDELL LOCHHEAD HUGHES, RAYMOND EMORY MEEK, CONRAD BERENS, BRITAIN FORD PAYNE, WILLIS SACKETT KNIGHTON.

## THE NEW YORK HOSPITAL

## Monday

## General surgery—2.

ERNEST WILLIAM LAMPE. Surgical anatomy demonstration: detailed anatomy of hand and wrist as involved in infection and trauma.

## Otolaryngology: Operative clinic—2.

ARTHUR PALMER. Reconstructive surgery of the nose.

## Tuesday

## General surgery—9

GEORGE JULIUS HEUER and staff. Operative and dry clinics

GEORGE JULIUS HEUER. Follow-up study of treatment of peptic ulcer.

CRANSTON WILLIAM HOLMAN. Bleeding peptic ulcer WILLIAM COOPER. Diagnosis of stomach lesions.

EDGAR COOPER PERSON, JR. Gastrojejunocolic fistula WILLIAM BARNES. Carcinoma of the head of the pancreas.

## General surgery, dry clinic—2

GEORGE JULIUS HEUER and staff.

WILLIAM DE WITT ANDRUS. Follow-up results. Aneurysm of large vessels.

WILLIAM COOPER. Follow-up results—carcinoma of breast, stomach, colon, rectum.

BRONSON SANDS RAY. Organization of follow-up clinic. Follow-up clinic staff. Demonstration.

ERNEST WILLIAM LAMPE. Surgical anatomy demonstration—anatomy of neck as regards radical neck dissection.

## Genitourinary surgery—9.

ERNEST WILLIAM LAMPE. Surgical anatomy demonstration of male perineum.

## Otolaryngology: operative clinic—2.

GERVAIS WARD MACAULIFFE. Surgery of the mastoid.

## Urology (Cornell)—2.

VICTOR MARSHALL.

E. CRAIG COATS. Results of untreated bladder carcinoma.

VICTOR FRAY MARSHALL. Results of radiation treatment.

MARTIN SPATZ. Autopsy findings.

ARCHIE LEIGH DEAN, JR. Physical factors limiting radiation treatment.

JEREMIAH EDWIN DREW. Results in bladder resection.

ALISTER MATHESON McLELLAN. Results of fulguration and simple excision.

GUSTAVUS ALDRIDGE HUMPHREYS. Results of ureterocutaneous anastomosis.

DAVID H. MACFARLAND. Results of ureterointestinal anastomosis.

MORRIS SCHNITTMAN. Results of cystectomy.

VICTOR FRAY MARSHALL. Summary.

## Wednesday

## General surgery—2.

ERNEST WILLIAM LAMPE. Surgical anatomy demonstration—anatomy of breast as regards radical mastectomy.

## Genitourinary surgery—2.

THOMAS JOSEPH KIRWIN. Operative and dry clinic: perineal prostatectomy.

ROSE HENRI ANDRÉ. Demonstration of spinal anesthesia.

ROY BIGGS HENLINE. Ureteropelvic obstruction.

GEORGE ADOLPH FIEDLER. Absorbable gauze in urologic surgery.

FRANCIS PATTON TWINEM. Case report.

## SURGERY, GYNECOLOGY AND OBSTETRICS

ROBERT W. HUNT. True adrenal tumor of kidney.  
CYRIL KLOCK CHURCH. Ureteral obstruction in relation to psychosis.

STANLEY LEON WANG. Treatment of bladder tuberculosis with a new instrument and method.

FRANCIS ANTHONY BENEVENTI. Glands in female urethra of the infant.

ALBERT VERGES-FLAUQUE. Foreign body in ureter.

THOMAS F. CONROY. Transplantation of ureters.

ALBERTO GENTILE. Case report.

DENNIS ALOYSIUS KELLEHER. Gastroenterological symptoms in urology.

CECIL HAWES. Case report.

WILLIAM P. DIDUSCH. Demonstration of drawings of interesting urological cases and operations. Motion pictures of urological operations.

Neurology—2.  
BRONSON SANDS RAY, HAROLD GEORGE WOLFF, JOSEPH HINSEY.

BRONSON SANDS RAY. Surgical treatment of cardiac pain.

CHARLES M. BERRY and JOSEPH HINSEY. Studies in regeneration of peripheral nerves.

CHARLES LAMAR NEILL, JR. Intracranial aneurysms.

DONALD SIMON and HAROLD GEORGE WOLFF. Studies of post-traumatic headache.

HERBERT PARSONS. Ruptured disks of the cervical region.

ARTHUR CONSOLE. Sympathetic innervation of the extremities.

BRONSON SANDS RAY. Results of sympathectomy for hypertension.

BRONSON SANDS RAY and staff. Neurosurgical case reports.

Thoracic surgery—9.  
GEORGE JULIUS HEUER and staff. Operative and dry clinic.

GEORGE JULIUS HEUER. Constrictive pericarditis.

WILLIAM deWITT ANDRUS. Surgery of mediastinal tumors.

JOHN HAAG ECKEL. Follow-up studies of mediastinal tumors.

HENRY ARNOLD CROMWELL and WILLIAM ALEXANDER BARNES. Clinical value of sputum diagnosis.

Otolaryngology. Operative clinic—2.  
SAMUEL F. KELLEY. Surgery of the paranasal sinuses.

## Thursday

General surgery—2.

GEORGE JULIUS HEUER. History of operative procedure for acute cholecystitis.

NATHAN CHANDLER FOOT. Pathology of acute cholecystitis.

FRANK GLENN. Surgical treatment of acute cholecystitis.

SAMUEL WILSON MOORE. Complications of acute cholecystitis.

ERNEST WILLIAM LAMPE. Surgical anatomy demonstration—anatomy involved in lumbar and thoracolumbar sympathectomy.

Plastic and faciomaxillary surgery—9.  
HERBERT CONWAY. Operative and dry clinic; one stage push back operation for congenitally short palate; results following treatment of carcinoma of the head and neck; case presentations.

E. FREUD. Speech therapy in cases of cleft palate.

CHARLES NEWMAN. End-results following radical breast amputation with split skin grafting.

JAMES DINGWALL. Adult tissue extract in wound healing.

Otolaryngology: Dry clinic—2.  
ARTHUR PALMER and associates. Case presentations and postoperative result—laryngofissure, carcinoma of trachea, mastoiditis with petrositis and meningitis, acute frontal sinusitis with meningitis.

Ophthalmology: Operative clinic—9.  
JOHN McLEAN and staff. Intracapsular cataract. Glaucoma.

## Friday

General surgery: Dry clinic—2.

GEORGE JULIUS HEUER and staff.

GEORGE PAPANICALAOU. Diagnosis of carcinoma from disquamated cells.

FRANK GLENN and DAN CUMMINGS GILL. Clinical results of the use of streptomycin.

SAMUEL WILSON MOORE. Follow-up studies of polyps of the large intestine.

JAMES DINGWALL. Adult tissue extract in wound healing.

ERNEST WILLIAM LAMPE. Surgical anatomy demonstration; anatomy of region involved in lobectomy and pneumonectomy.

Surgery of the bones and joints.

NELSON WARREN CORNELL—9. Operative clinic.

CHESLEY EVAN SMITH. Volkmann's ischemic paralysis.

ARTHUR CONSOLE. Threatened Volkmann's paralysis prevention by sympathetic block.

PRESTON WADE. Massive onlay bone grafts for ununited fractures.

BERNARD MAISEL. Table fracture of tibia; conservative treatment.

BROADMAN MARSH BOSWORTH. Fixation of acromioclavicular separation.

NELSON CORNELL. End-results; fracture of neck of femur treated with Moore nails.

Otolaryngology: Operative clinic—2.  
THOMAS JOSEPH GARRICK. Surgery of the oropharynx and nasopharynx.

## NEW YORK ORTHOPEDIC HOSPITAL

Operative clinics—8.

## Monday

Presentation of postoperative patients of many years' follow-up—8.

## Tuesday

Operative clinics—8.

## Wednesday

Grand rounds with chief surgeon at the New York Orthopedic Dispensary and Hospital, ALAN DEFOREST SMITH

## Thursday

Operative clinics—8.

## Friday

Out-patient clinic in the dispensary—1:30 p.m. to 4:30 p.m.

NEW YORK ORTHOPEDIC HOSPITAL  
FRACTURE SERVICE

## Monday

SAWNIE RENARD GASTON—1:30. Problem fractures with follow-up results.

## Tuesday

CLAY RAY MURRAY and staff—9. Operative clinic. Fracture follow-up clinic—1:30. X-ray review—4.

*Wednesday*

- CLAY RAY MURRAY and staff—9. Operative clinic.  
 HARRISON LLOYD McLAUGHLIN—1:30. Shoulder cuff injuries and recurrent shoulder dislocations with follow-up results.  
 BARBARA BARTLETT STIMSON—3. The low back problem with follow-up results.

*Thursday*

- CLAY RAY MURRAY and staff—9. Operative clinic.  
 FREDERICK MERWIN SMITH—1:30. Complicated elbow fractures with follow-up results.  
 STEPHEN SYLVESTER HUDACK—3. Collagen and organic salt; combination for bone displacement.

*Friday*

- Fracture Service Grand Rounds and Conference: Significance of blood volume studies in trauma—9.  
 CLAY RAY MURRAY—2:30. Role of sympathetic system in the surgery of trauma.

## NEW YORK POST-GRADUATE HOSPITAL

*Monday*

- Operative clinic—9. Diseases of gall bladder and bile ducts.  
 RUPERT FRANKLIN CARTER—11. Dry clinic. Follow-up results.  
 JAMES WILLIAM HINTON—2. Operative clinic.

*Tuesday*

- Follow-up results—9.  
 GEORGE ANOPOL—10:30. Operative clinic.  
 GUSTAV AUFRICHT—10:30. Case illustrations in operative procedures in plastic surgery.  
 WALTER TAYLOR DANNREUTHER—2. Operative clinic: gynecology.

*Wednesday*

- Operative clinic—9. Neurosurgery.  
 JOHN ARTHUR MACLEAN, JR.—9. Follow-up clinic patient illustration.  
 BERNARD MARRAFFINO—11. Value of immediate and delayed cholangiography in the surgical management of common duct disease. Case illustration.  
 Follow-up results in advanced common bile duct lesions. Case illustrations—12.  
 CHARLES GORDON HEYD—2. Operative clinic: General surgery.

*Thursday*

- HERBERT WILLY MEYER and ROBERT HAYWARD KENNEDY—9. Operative and dry clinic on problems in surgery of tumors of breast, head, and neck.  
 HENRY HAUSMAN RITTER—2. Operative and dry clinic in traumatic surgery.  
 Ophthalmology—2.  
 RUDOLF AEBLI and HAROLD BROWN. Eye muscle operations.

*Friday*

- CARNES WEEKS—9. Operative clinic: Surgery in hypertension.  
 GERALD HILLARY PRATT—10:30. Operative clinic: diseases of the vascular system.  
 THOMAS HENDRICK RUSSELL—2. Operative clinic: general surgery.

## PRESBYTERIAN HOSPITAL

*Monday*

- Dry clinic—2.  
 EDWARD LEE HOWES. Experimental production of carcinoma of stomach.  
 HUGH AUCHINCLOSS. Twenty year follow-up in carcinoma of the breast.

- ARTHUR PURDY STOUT. The relation of chronic cystic disease to cancer of the breast.  
 CUSHMAN DAVIS HAAGENSEN. The problem of early diagnosis in cancer of the breast.  
 MAURICE LENZ. Roentgentherapy of cancer of the breast in non-operated cases and as a preoperative and postoperative treatment.  
 CUSHMAN DAVIS HAAGENSEN. Surgery versus radiation in cancer of the breast.

*Tuesday*

## Dry clinic—2.

- HAROLD DORTCH HARVEY. Blood volume studies in surgical patients.  
 OCTA CHARLES LEIGH. Physiological studies in injuries due to cold.  
 SIDNEY CHARLES WERNER. Use of amino acids in pre-operative and postoperative nutrition.  
 EDWARD BALDWIN SELF. Serum versus plasma.  
 FENNEL PARISH TURNER II. Use of dextran in surgical patients.  
 JOHN SCUDDER. Experience with human albumin.

*Thursday*

## Dry clinic—2.

- LOUIS BAUMAN. Diagnosis of pancreatic disease.  
 WILLIAM BARCLAY PARSONS. Surgery of tumors of the ampulla of Vater and head of pancreas.  
 ROBERT HARE ELLIOTT, JR. Experiences with propacil in thyroid diseases.  
 EDWARD LEE HOWES. Use of streptomycin and sulfonyl to prevent wound infection.  
 RUDOLPH NICHOLAS SCHULLINGER. Observations on acute appendicitis at Presbyterian Hospital 1916-1946.  
 FRANK LAMONT MELENY. Recent laboratory and clinical experiments with the new antibiotic bacitracin.

*Friday*

## Dry clinic:

- VIRGINIA KNEELAND FRANTZ. Hemostasis with absorbable gauze.  
 ARTHUR HENDLEY BLAKEMORE. Wiring of aneurysms  
 JOHN MUNN HANFORD. Carcinoma of the tongue, follow-up results.  
 LAWRENCE WELLS SLOAN. Follow-up results in thyroid operations.  
 ROSS GOLDEN. Pathological physiology in the intestine induced by adhesions.  
 HENRY SAGE COOPER. Practical considerations in intestinal obstruction.

PRESBYTERIAN HOSPITAL  
BABIES HOSPITAL*Friday*

- Members of the staff—9. Operative clinic.  
 Presentations of current cases—11.  
 Dry clinic, follow-up studies—2.  
 EARL C. TAYLOR. Appendicitis.  
 BRUCE MACLEAN HOGG. Intussusception.  
 LOUIS MARCEL ROUSSELOT. Banti's syndrome.  
 GEORGE HUMPHREYS II. Esophageal atresia.  
 EDWARD BALDWIN SELF. Acute osteomyelitis.

PRESBYTERIAN HOSPITAL  
NEUROLOGICAL INSTITUTE*Monday*

- FRITZ CRAMER (time to be announced). The surgical treatment of syringomyelia; the surgical treatment of the neuralgias of the facial and vagus nerves; cases of bilat-



# SURGERY, GYNECOLOGY AND OBSTETRICS

eral parasagittal meningiomas with excision of the longitudinal sinus.

CLEMENT BUCHANAN MASON (time to be announced). Experiences in the removal of metallic foreign bodies from the brain with the use of a Berman locator.

LESTER ADRIAN MOUNT (time to be announced). A plea for early recognition and early operation. A new type of operative procedure; congenital dermal sinus, lumbosacral, thoracic, and occipital, associated with subdural abscess, meningitis or abscess of the spinal cord.

## Tuesday

BYRON POLK STOOKEY (time to be announced). Dermoid tumors of the spinal cord.

JOHN EDWIN SCARFF and J. LAWRENCE POOL (time to be announced). Factors contributing to massive involuntary spasm in paraplegic patients; report on the treatment of hydrocephalus in infants.

EDWARD B. SCHLESINGER (time to be announced). The treatment of spastic states.

## Thursday

MARION BECKETT HOWORTH. Management of unusual fractures of the femoral neck. Case presentations (illustrations).

JAMES EDWIN THOMPSON. Compound fracture at the knee joint (illustrated). Case reports.

## Friday

Malignant disease of the female pelvic organs—9. WILLIAM PATRICK HEALY. Hysterectomy for cancer results in cancer of the female pelvis: discussion and demonstration of results of surgery and irradiation.

Surgery of the genitourinary tract—2. SIMON ANTHONY BEISLER. Suprapubic prostatectomy (operation). Presentation of patients illustrating results of urological procedures.

## Saturday

Surgery of the stomach—9. HOWARD A. PATTERSON. Subtotal gastrectomy (operation). Presentation of cases illustrating late results of gastric surgery, with particular reference to gastric tumors (illustrated).

WALTER WILLIAM BRANDES. Demonstration of stomach tumor specimens.

GRANT PALMER PENNOYER. The rôle of a vascular clinic in a general hospital (illustrated). Demonstration of cases.

DAVID MERRILL WEEKS. The observed effect of various drugs on intestinal activity (moving picture demonstration).

## ST. LUKE'S HOSPITAL

### Monday

GEORGE FRANCIS HOCH. 2. Congenital ureterectasis.

JOHN ARTHUR TAYLOR. 2:30. Testicular tumors.

CRAIG COATES. 3. Bladder tumors.

JAMES R. WAUGH. 3:30. Uteropelvic obstruction.

Otolaryngology.

WESTLEY MARSHALL HUNT. Bronchoscopic diagnosis of carcinoma of lung.

JOHN WINSTON FOWLER. The use of penicillin in otolaryngological surgery.

### Tuesday

WILLIAM FRANK MACFEE and staff—8:30. Operations.

ALEXANDER WILLIAM ADA—11. Review of surgery of stomach and duodenum.

FRED PALMER SOLLEY—11:30. Case reports—3 cases subtotal gastrectomy for massive hemorrhage.

JOHN COOPER—12. Experience with cure in prolonged operations.

MORRIS KELLOGG SMITH and GEORGE MUNRO GOODWIN—12:30. Results in surgery for toxic goiter with special reference to the use of thiouracil.

MATHER CLEVELAND—2. Hazards of external fixation in skeletal traction.

DAVID MARSH BOSWORTH—2:30. Difficult fractures.

Management and end-results.

FRED THOMPSON—3. End-results in 100 trochanteric fractures of the femur.

BORIS PETROFF—4:30. Neurogenic bladder.

### Wednesday

WILLIAM FRANK MACFEE and staff—8:30. Operations.

WILLIAM FRANK MACFEE—11. Carcinoma of colon at rectosigmoid junction, management.

EDWARD JOSEPH DONOVAN—11:30. Ten year study of carcinoma of colon exclusive of rectum.

PAUL CALHOUN MORTON—12. Polyps of rectum and sigmoid, management and treatment.

## PRESBYTERIAN HOSPITAL THE INSTITUTE OF OPHTHALMOLOGY

### Monday

ALGERNON BEVERLY REESE and staff—2. Surgical procedures in glaucoma and cataract.

### Tuesday

GORDON MURPHY BRUCE and staff—2. Operative clinic.

RAYMOND CASTROVIEJO—2. Surgery of the cornea.

### Wednesday

JOHN HUGHES DUNNINGTON—2. Surgery of the extraocular muscles and intraocular operations.

## ROOSEVELT HOSPITAL

### Monday

Traumatic and reconstructive surgery of the hand—2.

HENRY AUGUSTUS KINGSBURY. Early treatment and management of injuries (illustrated).

R. STERLING MUELLER. Late repair and restoration of injured flexor tendons (illustrated, case presentations).

CONDUCT WALKER CUTLER, JR. Reconstructive surgery of bones of the hand (illustrated).

### Tuesday

Surgical treatment of lesions of the colon—9.

HENRY WISDOM CAVE. Subtotal colectomy (operation) for ulcerative colitis. Rounds and demonstration of patients.

Surgical treatment of lesions of the colon—2.

FREDERICK HENRY AMENDOLA. Results of resection of tumors of the colon, case reports (illustrated).

HENRY WISDOM CAVE. Sequelae, complications, and late results of the surgical treatment of ulcerative colitis. (Motion pictures of technique of ileostomy and colectomy. Presentation of cases showing late results.)

WALTER WILLIAM BRANDES. Pathology of ulcerative colitis. Gross and microscopic specimens (illustrative lantern slides).

### Wednesday

Cancer of the breast—9.

WILLIAM CRAWFORD WHITE. Radical mastectomy (operation). Rounds, presentation of cases and illustration of late results.

Problems of fracture therapy—2.

WILLIAM HENRY CASSEBAUM. Presentation of cases illustrating various fractures and their complications (illustrations).



- BENJAMIN RICE SHORE, JR.—12:30. Carcinoma of breast. Ten year follow-up report.  
JOHN WINSTON FOWLKES and staff—2. Operations or ward rounds.  
JOHN WINSTON FOWLKES—3. Penicillin as an adjunct to surgery in otolaryngology.  
WESLEY MARSHALL HUNT—3:30. Bronchoscopic diagnosis in carcinoma of lung.

*Thursday*

- WILLIAM FRANK MACFEE and staff—8:30. Operations.  
MORRIS KELLOGG SMITH—11. Vascular surgery in war injuries.  
FRANKLIN STAFFORD WEARN—11:30. Pulmonary embolism.  
ALEXANDER WILLIAM ADA—12. End-results in lobectomy for bronchiectasis; case report; constrictive pericarditis (calcified), operation and end-result.  
JOHN JACOB WESTERMANN, JR.—12:30. Case reports. Surgery of ulcerative colitis.

*Friday*

- WILLIAM FRANK MACFEE and staff—8:30. Operations.  
JOHN WEST—11. Inguinal hernia, study of cases and end-results.  
WILLIAM BERRY—11:30. Case report, carcinoma ampulla of Vater, Operation and end-result.  
HERBERT PARSONS—12. Penetrating head injuries war experience.  
JOHN WEST—12:30. Case report, lymphosarcoma of small intestine with metastases to extremity.  
WALTER GURNSEY FREY—2. Blood pressure variations in ophthalmological operations under local anaesthesia.  
WALTER GURNSEY FREY and staff—2:30. Operations or ward rounds.

## ST. VINCENT'S HOSPITAL

*Tuesday through Friday*

- RAYMOND PETER SULLIVAN and GEORGE R. STUART and staff—9. Surgical operations.  
JOHN FRANCIS McGRATH and staff—9. Gynecological operations.  
C. G. DE GUTIERREZ-MAHONEY and staff—9. Neurosurgical operations.

*Monday*

- Dry clinic—2. Hodgkin's disease symposium.  
JOHN FRANCIS KEATING—Clinical findings.  
WILLIAM WALLACE MAVER. X-ray findings and x-ray therapy.  
ANTONIO ROTTINO. Pathological findings.  
GLADYS CAMERON and COATA GRAND. Experimental studies.

*Tuesday*

- Dry clinic—2. Surgical.  
RAYMOND PETER SULLIVAN. Biliary tract reconstruction.  
FRANK JOSEPH MCGOWAN. What civilian surgery has learned from the war.  
DANIEL A. MULVIHILL. Decortication of the pleura—a new operation for non-expandable lungs.  
CONSTANTINE JOSEPH MACGUTHRIE, JR. Pancreatitis.  
BERNARD D. HANNAN. Acute cholecystitis, immediate versus delayed operation.

*Wednesday*

- Dry clinic—2. Neurosurgical.  
J. T. DANIELS. A new method for reducing extensive nerve defects.  
A. GRINO. Morphology of the oligodendroglia demonstrated by a new method.  
C. G. DE GUTIERREZ MAHONEY. The treatment of phantom limb pain.  
W. G. KUHN, JR. Care and rehabilitation of the paraplegic patient.

*Thursday*

- Dry clinic—2. Surgical.  
GEORGE R. STUART. Résumé of cancer studies over 4 years.  
GEORGE VAN GILLUWE. Advantages of the use of compressed air in anesthesia.  
EDWARD VICTOR DENNEEN. Fractures of both bones of the leg.  
MAURICE CULMER O'SHEA. Fractures of the os calcis—200 cases.  
T. M. HOWLEY. Carcinoma of the kidney.

*Friday*

- Dry clinic—2. Gynecological.  
JAMES PATRICK HENNESSY. Cesarean section.  
ALEXANDER HUNTER SCHMITT. Multiple cesarean sections.  
THOMAS EUGENE LAVELL. Ovarian neoplasma.  
BERNARD JOSEPH PISANI. The program for gynecological care in the Veterans Administration.  
Dry clinic—2. Otolaryngological.  
JOHN MARION LORE and staff. Speech clinic, etc.

## WOMAN'S HOSPITAL

*Monday, Wednesday and Friday*

- ALBERT HERMAN ALDRIDGE, LEE MAIDMENT HURD, WILLIAM T. KENNEDY, and RALPH A. BARRETT—8:30 a.m. to 12:00 noon. Operative clinics.  
Demonstrations: Treatment of neoplasms of the pelvic organs, uterine displacements, birth injuries. End-results of the procedures will be discussed.

# SURGERY, GYNECOLOGY AND OBSTETRICS

## PRELIMINARY CLINICAL PROGRAM

### BROOKLYN. LONG ISLAND HOSPITALS

#### BROOKLYN EYE AND EAR HOSPITAL

*Wednesday*  
Daily operative clinic.  
Demonstrations by surgeons of the staff of the Brooklyn Eye and Ear Hospital.  
Late results in detachment of retina.  
Late results in cataract extraction.  
Late results in fenestration.  
Late results in dacryocystorhinostomy.

*Thursday*  
Daily operative clinic.  
Demonstrations by surgeons of the staff of the Brooklyn Eye and Ear Hospital.  
Late results in facialomaxillary surgery.  
Late results in laryngectomies.  
Late results in glaucoma surgery.  
Angioscotometry exhibit.

#### CUMBERLAND HOSPITAL

*Monday*  
General surgery—2. Discussion of postoperative complications. Use of sulfanamides in acute abdomen. Preoperative and postoperative treatment in gastrointestinal surgery. Advantages of Miller Abbott tube in small bowel obstruction. Late results in the surgery of gastrointestinal malignancy with pathological demonstration

*Tuesday*  
Obstetrics—gynecology—9  
SAMUEL LUBIN and staff. Operations.  
CHARLES H. LOUGHRAN and staff. Preoperative and postoperative care of gynecological patients.  
HERBERT T. WIKLE. Procidencia, demonstration of technique for its relief, 15 year follow-up.  
Late results in pelvic malignancy.  
Obstetrics—gynecology—2.  
Gynecological abnormalities in youth—2 case reports.  
SILK H. POLAYES. Isoimmunization with A and B factors in erythroblastosis fetalis.  
LESLIE H. TISDALL. Importance of blood and blood derivatives in obstetrics.  
RICHARD WALTMAN. Conservative management of abortions. Thrombophlebitis after pelvic operations.  
CHARLES H. LOUGHRAN. Bacillus welchii postpartum infection—late results.

*Wednesday*  
General surgery—9.  
JOHN J. GADNEY and staff. Gastrectomy for carcinoma of the stomach with discussion of late results.  
JOHN A. TRIM and staff. Ward rounds, discussion of the surgical gall bladder with late results.  
HOWARD T. BLAIR. Ward rounds with discussion of surgery in large bowel malignancy. Retroperitoneal teratoma with slides.  
General surgery—2.  
JOSEPH I. ANTON. Arteriovenous fistula with follow-up, uterus with follow-up.  
SILK H. POLAYES. Granuloma inguinale (venereum) of WILLIAM H. FIELD. Thoracic surgery in general hospital.  
JOHN A. TRIM. Common duct atresia.  
SAUL F. LIVINGSTON. Congenital esophageal atresia.  
MARTIN H. LUTZ. Traumatic evisceration with follow-up.

*Thursday*  
Fractures and other traumas—9.  
LEO FASKE and staff. Pinning for femur neck fracture.  
Late results in fracture of femur neck.  
JOSEPH I. ANTON. Traumatic abdomen.  
Ward rounds with x-ray studies of various types of fractures.  
Fractures and other traumas—2.  
JOSEPH I. NEVINS and staff. Non-union, late results and general discussion.  
Ward rounds with demonstration of apparatus in use.  
Gadgets and their use in fracture treatment.  
FRANK TURNEY. Head injuries, late results.

*Friday*  
Urology—9.  
HOWARD T. LANGWORTHY and staff. Carcinoma of prostate. Orchietomy for prostatic metastases—late results.  
LEO S. DREXLER and staff. Carcinoma of bladder with transplantation of ureter—late results.  
General surgery—2.  
Thrombophlebitis after pelvic operations. Late results in thrombophlebitis and phlebothrombosis. Embolotomy for riding embolus of abdominal aorta. Complications during anesthesia—late results. Late results in surgical jaundice.

#### HOUSE OF ST. GILES THE CRIPPLE

*Wednesday*  
JOSEPH L. L'EPISCOP, JOSEPH GIANQUINTO, CARMELO VITALE. Orthopedics:  
Dry clinic. Abduction traction splint for congenital dislocation of hip. Demonstration of cases. Follow up clinic on foot reconstruction for poliomyelitic instability—results following Hoke, Naughton-Dunn, Lushbrud and astraglectomy stabilizations. Shoulder fusion for poliomyelitic flail shoulders—5 year follow-up. Demonstration of cases. Follow-up on selection of cases. Recurrent club-foot. Demonstrations of cases following resection of head of talus plus transplantation of anterior tibial tendon.

#### JEWISH HOSPITAL

*Tuesday*  
Operative clinic—8.  
LOUIS BERGER and staff.  
Dry clinic—10.  
LOUIS J. MORSE and JACOB S. BARR. Fascial transplants in repair of large incisional hernia.  
ALFRED L. SHAPIRO. Configuration and variations of the duodenal choledochal and middle colic arteries.  
LEWIS E. SCROTTENFELD. Bacillus welchii infections of the biliary tract.  
BERNARD PINES. Postoperative obstruction of the bile duct treated with vitalium tube.  
HYMAN I. BERSON and PAUL W. ASCHNER. Pitfalls in the diagnosing and surgical therapy of obstructive jaundice.  
BENJAMIN M. BERNSTEIN. Critical review of peptic ulcer therapy.  
DAVID FARBER. Carcinoma of small bowel.

- SAMUEL ACHS. Bowel perforation with Miller Abbott Tube.  
 LOUIS BERGER. Restoration of alimentary continuity in carcinoma of rectum.  
 Operative clinic—1:30.  
 ISADORE M. TARLOV. Plasma clot suture of peripheral nerve.  
 Neurosurgical dry clinic—3:30.  
 JOSEPH H. SIRIS and staff.

*Wednesday*

- Operative clinics—8.  
 HENRY W. LOURIA and staff.  
 RUDOLPH NISSEN and staff.  
 Dry clinic—10.  
 IRVING M. PALLIN. Curare and endotracheal anesthesia in poor risk patients.  
 EDWARD HIRSCH and LEO LOEWE. Treatment of post-operative phlebothrombosis with subcutaneous heparin.  
 SAUL F. LIVINGSTON. Bleeding nipple.  
 LEW A. HOCHBERG. Paradoxical respiration; its cause, consequence, and treatment.  
 RUDOLPH NISSEN. Endothoraphy as surgical procedure in the treatment of giant air cysts of the lung.  
 VICTOR WORONOV. The use of thiouracil in the surgical management of toxic goiter.  
 ARTHUR A. WEINBERG. The diagnosis and surgical treatment of thyroiditis.  
 FRANK TELLER. Malignant tumors of the thyroid gland—diagnosis, management and end-results.  
 HENRY W. LOURIA. Surgical management of goiter.  
 Dry clinic: Orthopedics—2.  
 S. A. BERNSTEIN. Operative correction of Hammer toes by resecting the middle phalanx.  
 MORRIS T. KOVEN. Pre-standing cases of congenital subluxation of the hip.  
 LOUIS S. NELSON. The conservative management of slipping of the upper femoral epiphysis.  
 BENJAMIN KOVEN. The use of the Austin Moore plate and its modifications in high osteotomy of the femur.  
 LT. COL. JOSEPH E. MILGRAM. Reconstruction Key gliding mechanisms of the upper extremity.  
 A. E. SOBEL and BENJAMIN KRAMER. Composition of bone in relation to blood and diet.  
 BERNARD S. EPSTEIN. The application of laminography to some orthopedic problems.

*Thursday*

- Operative clinics—8.  
 PAUL W. ASCHNER and staff.  
 LEO S. SCHWARTZ and staff.  
 Obstetrics—gynecology—10.  
 E. GOLD. Pelvic drive in obstetrics.  
 ISIDORE DAICHMAN and WILLIAM POMERANCE. Extra peritoneal cesarean section.  
 HARRY J. GREENE. Phlebitis in obstetrics and gynecology.  
 SAMUEL A. WOLFE and IRVIN NEIGUS. Studies with gonadogen.  
 Dry clinic: Urology—10.  
 ABRAHAM D. SEGAL. Diagnosis and treatment of solitary cyst of the kidney by aspiration and injection.  
 LOUIS H. BARETZ. Treatment of hydrocele by sclerosing agent.  
 ZACHARY R. COTTLER and SAMUEL PARNASS. Periostitis and ostitis pubis complicating urological procedures.  
 PERRY KATZEN. Obstructive uropathy in children.  
 ISADORE KIMMEL and PAUL W. ASCHNER. Serum acid phosphatase in the diagnosis and management of carcinoma of the prostate.

## KINGS COUNTY HOSPITAL

*Monday*

- JOSEPH TENOPYR—10. Ward walks and demonstration of fractures.

*Tuesday*

- GEORGE A. DIXON—9. Operative clinic including gastrectomy, etc.  
 JOHN F. RAYCROFT—2. Discussion of fractures of the upper humerus illustrated with lantern slides and follow-up cases.

*Wednesday*

- JOSEPH TENOPYR—10. Demonstration of fractures and apparatus; visit to the occupational therapy department.  
 OTOKAR TENOPYR. Treatment of fractured patella by complete removal of patella and suture of ligaments of knee.

## KINGS COUNTY HOSPITAL—DEPARTMENT OF NEUROLOGICAL SURGERY

- M. FRANK TURNER. Glossopharyngeal neuralgia associated with cardiac arrest.  
 JEFFERSON BROWDER. Treatment of postherpetic pain by excision of the implicated skin.  
 RICHARD GRIMES. Modification of congenital spasticity by selected dorsal root rhizotomy.  
 EVERETT W. CORRADINI. Diagnostic use of combined angiography and ventriculography.  
 ARTHUR BACON. Bilateral aneurisms—one on each common carotid artery.  
 JOHN P. GALLAGHER. Dorsal cordotomy for painful phantom limb.

(Time to be announced)

LONG ISLAND COLLEGE OF MEDICINE  
(Kings County Hospital)*Wednesday*

- Dry clinic: Gastric surgery, late results. Biliary surgery, late results. Rectal surgery, late results.

*Thursday*

- Dry clinic: Early results following sympathectomy for peripheral vascular disease. The value of open bone surgery in early restoration of the patient.

## LONG ISLAND COLLEGE HOSPITAL

*Tuesday*

- Obstetrics and gynecology—a.m.  
 GEORGE M. PHELAN. Surgical management of Bartholin cysts.  
 MERVYN V. ARMSTRONG. Addison's disease complicated by pregnancy.  
 WILLIAM T. DAILY. Syphilis and pregnancy.  
 SAMUEL A. WOLFE. Endometrial study after x-ray therapy for polyhormonal amenorrhea.  
 SANFORD KAMINSTER. Ectopic kidney as a complication of labor.  
 JOSEPH CRESI. Heart disease and pregnancy.  
 Urology—p.m.  
 FEDOR SINGER and staff. Operations, demonstrations, cases, end-results.

*Wednesday*

- General surgery—a.m.  
 EMIL GOETSCH and staff. Operative program, thyroidectomy and other procedures.  
 EMIL GOETSCH, ARTHUR GOETSCH, ALBERT J. RITZMANN. Symposium on thyroid disorders.  
 GAETANO DEYOANNA. Curare in abdominal surgery.  
 HAROLD LAROE. Complications of Meckel's diverticulum.

# SURGERY, GYNECOLOGY AND OBSTETRICS

*Thursday*

Obstetrics and gynecology—*a.m.*  
 MORRIS GLASS. Postmenopausal bleeding.  
 ALEXANDER ROSENTHAL. Iontophoresis in the treatment of chronic pelvic infection.  
 ARTHUR S. MACGREGOR. Conservative management of placenta previa.  
 CARL TAFFTEN. Conservative management of the vagina.  
 CHARLES A. WEYMULLER. Measures for the protection of newborn infants.  
 HARVEY B. MATTHEWS. Chronic endocervicitis, pathology, symptoms and treatment.  
 VINCENT P. MAZZOLA. Sodium-pentothal in major obstetric and gynecologic surgery.

*Friday*

Fractures and other traumas—*a.m.*  
 S. POTTER BARTLEY and HAROLD LAROE. Surgery of trauma, demonstrations, cases, end-results.  
 General surgery—*a.m.*  
 PAUL ANSBRO. Modern trends in anesthesia.

## METHODIST HOSPITAL

*Monday*

Operative and dry clinic—*2.*  
 CHARLES A. ANDERSON, EINAR A. SUNDE and staff.  
 Otolaryngology.  
 JOHN A. FORD. Plastic surgery.

*Tuesday*

Operative clinic—*8.*  
 HAROLD K. BELL, SEYMOUR G. CLARK and staff. General surgery.  
 HENRY P. LANGE and staff. Orthopedic surgery.  
 Dry clinic—*2.*  
 HENRY F. GRAHAM, moderator. Symposium on gastric surgery.

*Wednesday*

Operative clinic—*8.*  
 PIERRE A. RENAUD, JOHN A. TIMM and staff. General surgery.  
 HOWARD T. LANGWORTHY and staff. Genitourinary surgery.  
 Dry clinic—*2.*  
 ARTHUR H. BOGART, moderator. General surgery and specialties.

*Thursday*

Operative clinic: Obstetrics and gynecology—*8.*  
 GEORGE H. DAVIS, HARRY W. MAYES, HENRY P.

HAGSTRÖM, HENRY S. ACKEN, STANLEY C. HALL and staff.  
*Friday*  
 Tumor clinic (late results)—*9.*  
 Hospital staff. PIERRE A. RENAUD, moderator.

## ST. JOHN'S HOSPITAL

*Monday*

General surgery—*8.*  
 Operative clinic. Ward rounds.  
 Plastic surgery—*8.*  
 Operative clinic. End-results in cleft palate. Demonstration of cases.

*Tuesday*

Gastrointestinal surgery—*8.*  
 Operative clinic. Ward rounds on gastro-intestinal pathology. Conference in x-ray department. Conference in laboratory. End-results in duodenal ulcer.  
 Thoracic surgery—*8.*  
 Operative clinic. Preoperative and postoperative care. Ward rounds—dry clinic. Discussion: Surgical treatment of bronchiectasis.

*Wednesday*

Goiter surgery—*8.*  
 Operative clinic. Preoperative and postoperative care. The abuse of thiouracil in hyperthyroidism. Ward rounds. End-results in toxic goiter.  
 Urology—*8.*  
 Operative clinic. End results. Heminephrectomy for horse shoe kidney. Cancer of ureter—end results. End-results in cancer of the bladder.

*Thursday*

Fractures and other traumas—*8.*  
 Operative clinic. Visit to fracture clinic. X-ray demonstrations of interesting fractures. End results in fractures of the femur ward rounds.  
 Gynecology—*8.*  
 Operative clinic. Demonstration of gross specimens of ovarian tumors. End-results in tumors of the ovary.

*Friday*

Surgery of the hand—*8.*  
 Operative clinic. Visit to the hand clinic. Motion pictures of operations for lesions of the hand—end results.  
 Round table discussion.  
 Ear, nose and throat surgery—*8.*  
 Operative clinic. Endoscopic procedures. Conference in x-ray department. General discussion.

August, 1946

**SURGERY**  
**GYNECOLOGY AND OBSTETRICS**  
*Supplement*

**INTERNATIONAL ABSTRACTS**  
**OF SURGERY**

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about one-half inch throughout the length of this layer. This, as performed by the writer since 1942, is almost exactly the method of placing the first layer of sutures advocated by Skinner and Duncan. The anatomical advantages of closing the internal ring deep to the cord and transferring the latter to the upper angle seem obvious.

6. The free margin of the sheath of the internal oblique muscle is then re-attached to the transversus aponeurosis adjacent to the inguinal ligament with cotton sutures, starting at the superior angle of the wound, and proceeding inferiorly only as far as one can go without tension. This brings the free margin of the internal oblique muscle well below the level of the newly reconstituted internal ring in every case.

7. The medial and lateral leaves of the external oblique aponeurosis have usually been stretched somewhat by a hernia of any size, permitting imbrication across the lower portion of the previous suture line without tension, deep to the cord. The medial leaf is usually brought across first, the lowest suture again being placed through all structures down to the pubis. These leaves are imbricated under only the slightest tension with cotton sutures as far superiorly as possible, the cord again being retracted superiorly and laterally in an oblique plane through all fascial layers. The imbricated external oblique aponeurosis is sutured to the underlying deep layer in the lower inch of the closure.

8. The *transfer* of the cord to the fat, with obliteration of the inguinal canal, has been described. The writer has tried to persuade his colleagues and his students for years of the incorrectness of the usual phrase "transplant" of the cord, and will persist in an apparently hopeless effort at accurate descriptive terminology. It is, perhaps, of interest that all the steps in the "complete" (full-length) revision, or plastic repair, of the wall, with the exception of the avoidance of the inguinal ligament in closure and the routine opening of the peritoneum in monolocular direct hernia, were part of the routine radical operation for inguinal hernia as performed by Willard Bartlett, Sr., in 1928 when the writer joined his father in the private practice of surgery.

A case can be made for the "limited" operation in which the transperitoneal exploration reveals only moderate dilatation of the internal ring (to less than half the total length of the posterior wall) and a firm lower portion. The writer sees no advantage to be gained by obliteration of the inguinal canal in such instances. High division and suture of the sac, excision of the upper portion of the cremaster muscle as described, and approximation of the margins of the internal ring behind the cord deal thoroughly with the situation at this simple stage. The mobilized internal oblique is replaced and closure in anatomical layers completes the operation. This procedure should supplant the Ferguson operation entirely, as it avoids damage to the internal oblique muscle, accurately diminishes the size of the internal ring and thereby restores the posterior wall at its point of weakness under these circumstances, which the Ferguson does not do. On the basis of his experiences in the service, and of the anatomical data referred to, the writer would expect this "limited" plastic repair to be the procedure of choice in nearly 50 per cent of adult males under 30 years of age, with far less frequency in patients above that age and in practically all children.

#### SUMMARY

There is a wide difference between the traditional conception of inguinal hernia and that which is currently postulated on the basis of recent clinical and anatomical observation. The resemblance is slight between Bassini's ideal of "the rebuilding of the hernial canal, as this exists under physiological conditions, that is, a canal with two openings, an abdominal and a subcutaneous, further, with two walls, a front and a back, through the middle of which the spermatic cord would run obliquely"—and our adoption of all available means to obliterate the canal. We know that we cannot bring the transversus and the internal oblique muscles to the inguinal ligament and make them stay there and we suspect that we damage them in making the attempt. We are confident that the margins of the transversus aponeurosis and of the transversalis fascia cannot be accurately de-

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head, the surgeon has the option of resorting to the Gill procedure. He has recommended the employment of arthrodesis of the hip joint in certain individuals for ununited fractures of the femoral neck in which any reconstruction procedure may be destined to failure. Such an arthrodesed hip joint achieves a stable, painless, weight-bearing member, even though it is stiff, and may be preferable in some individuals in whom stability is a very important requisite for recovery.

In considering the methods of treatment of ununited fractures of the neck of the femur in patients who have a viable head, the surgeon has the option of employing one of the operative procedures designed to achieve anatomical and physiological restoration, or of employing the reconstruction procedure. Various types of osteotomies have been widely employed with excellent results. The Lorenz and Schanz osteotomies have been modified until these procedures have become greatly improved and simplified. Hass described the application of the Lorenz bifurcation operation, particularly as it pertains to ununited fractures of the femoral neck. The object of the original Lorenz and Schanz osteotomies was the attempt to overcome lateral stress of the fractured femoral neck on the head, so that the distal portion of the neck would assume a position inferior to the head, instead of lateral to it, thereby eliminating the shearing force of the neck and trochanter on the head. In the original operation, it was considered that a good result had been obtained merely when this shearing force was overcome and the head was resting directly on the ununited distal portion of the neck. These operative procedures entailed considerable sacrifice of length and, in spite of the fact that there was greater stability in the hip joint, some of these individuals continued to have pain and restriction of movement with resultant functional impairment and disability.

There have been many modifications of the osteotomy, but the McMurray type of high oblique osteotomy has been by far the greatest advance in the treatment of ununited fractures of the femoral neck. When this type of osteotomy was performed, it was found that not only had the operation completely overcome the shearing force of the neck on the head, but also that union of the osteotomy surfaces, and, in a great number of instances, between the ununited head and neck, had been achieved. As a matter of fact, a great number of cases have been reported in which union has occurred following osteotomy even as late as 2 years after the occurrence of the original

fracture. As a consequence, there was also less sacrifice of length of the leg than in the Lorenz and Schanz procedures.

Because of these improvements, the criteria for good end results have been completely revised. A good end result now implies complete correction of the shearing force of the neck on the ununited head, with union of fragments, less shortening, a remarkably increased range of motion, very little pain or discomfort, and a surprising restoration of function. The reports from many sources indicated a marked reduction in the mortality rate, no postoperative shock, almost no postoperative infection, and a minimal period of disability. As a consequence, the percentage of good end results from the McMurray type of osteotomy has been reported to have increased over that of the many other procedures which had been advocated.

Since the osteotomies have all been considered more or less "blind" or subcutaneous operations, difficulty was encountered in gauging the proper level of the osteotomy. The high oblique osteotomy has been preferable because it was designed to impinge the neck directly under the head so that the weight-bearing alignment would follow directly downward from the head into the shaft, completely shunting off the angle of the neck of the femur. The object of the high osteotomy, as reported by McMurray, has been to attain better apposition of the ununited fractured surfaces, and it is believed that the attachment of the muscles to the lesser trochanter greatly assisted in drawing the distal fragment medially, and maintaining this apposition. It is therefore advisable, if possible, to direct the osteotomy above the level of the trochanter, as advocated by McMurray. In spite of careful planning of the site for the osteotomy, some osteotomies have been done either too high or too low, resulting in failure of this operation. The writer suggested the insertion of the Steinman pin or drill at the proposed site of the osteotomy, and checking the hip roentgenographically before the osteotomy was finally performed.

Leadbetter's recent cervical-axial operation for ununited fractures of the femoral neck is unquestionably a great advance in the treatment of this condition. This operation completely eliminates the "blind" phase of the osteotomy by presenting a very simple exposure over the site of the ununited femoral neck, and permits performance of the osteotomy directly through the desired site. By visualizing the area one can correctly gauge the level for the osteotomy, thus achieving even less sacrifice of length than in other procedures. At the same time, the surgeon more easily implants the distal fragment under the

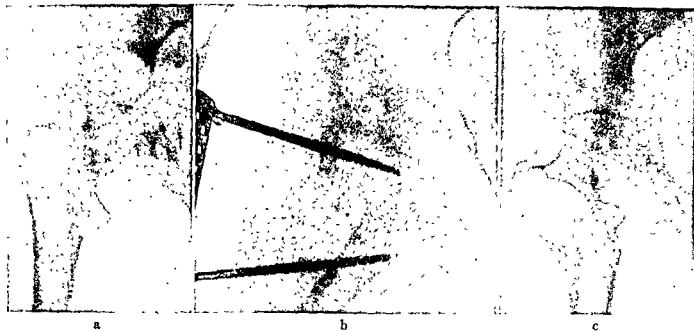


Fig. 1. A, Ununited fractures of the femur 4 months following fracture. B, Same patient as in A, showing position of fracture following a low Schanz osteotomy, with Schanz screws and Riedel plate in place. C, Same patient.

Roentgenogram 1 year following Schanz osteotomy, showing solid bony union of ununited fracture. Result excellent. Patient climbs stairs and laces shoes without difficulty. (Schumm, H. C.: *J. Bone Surg.*, 1937, 19: 955.)

head and neck, and thus observes the exact position that has been accomplished.

In his consideration of the osteotomy, Leadbetter has very succinctly catalogued six criteria for an ideal osteotomy, namely:

1. Preservation of the articulation of the head and the acetabulum.
2. Establishment of a normal acetabular thrust.
3. Creation of positive pressure by a true valgus.
4. Allowance for contact of cancellous bone surfaces.
5. Preservation of adequate circulation.
6. Production of minimal shortening.

The Brackett operation also was designed to implant the remnant of the neck or trochanter into the femoral head by visualization through operative exposure, and Ghormley recently reported a series of patients on whom this reconstruction procedure was employed with good results. Some surgeons consider the Brackett operation somewhat similar to the Leadbetter procedure. The ununited fracture is exposed by open operation and after the greater trochanter has been divided by osteotomy, the remnant of the neck or trochanter is implanted directly into the ununited fractured head which has been freshened and slightly gouged out.

Blount has advocated the use of a blade-plate as a means of internal fixation following femoral osteotomies, for the purpose of eliminating the necessity of the application of the hip spica cast.

He considers the hip spica a distinct detriment to the patient's welfare because of the enforced period of recumbency, and the application of a blade permits more rapid convalescence and earlier weight bearing and locomotion.

#### DISCUSSION

The selection of the proper type of operative procedure for the relief of ununited fractures of the neck of the femur is dependent upon many factors, and the state of the ununited femoral head is extremely vital in its selection. Whether the head is viable or not is, of course, of first consideration in the selection of the proper procedure. If the head has undergone aseptic necrosis or secondary arthritic change, one must immediately eliminate all types of operations designed to restore anatomical and physiological function. Any type of osteotomy is also contraindicated. The choice of operative procedure lies between arthrodesis of the hip joint, as recommended by Gill, or the Whitman reconstruction operation in which a portion of the trochanter and neck is implanted into the acetabulum after the removal of the necrotic head, with the trochanter transplanted downward, or the Colonna operation, in which the greater trochanter is directly implanted into the acetabulum after the removal of the head.

In those instances in which the original fracture of the femoral neck has occurred far medially at the junction of the head and the neck, leaving

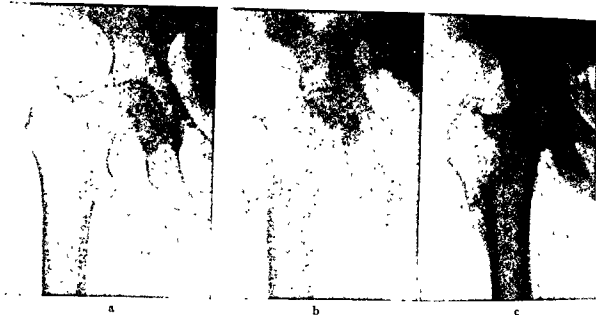


Fig. 2-A, Roentgenogram taken January 16, 1940 showing fracture of neck of femur with coxa vara of 6 weeks' duration. B, Roentgenogram taken April 6, 1940, of high oblique osteotomy, showing coxa vara completely corrected

with lesser trochanter directly under head. C, Roentgenogram taken August 17, 1940 showing union of osteotomy and femoral neck, head and trochanters in excellent relation to shaft. (Reich, R. S.: *J. Bone Surg.*, 1941, 23: 141.)

a small remnant of the head in the acetabulum, even though viable, the various osteotomies may also be contraindicated, because of the lack of adequate purchase of the neck on the remaining head. Failures have frequently resulted from the osteotomies in which these conditions have prevailed. For this reason, such a small remaining head, even though viable, may also be considered additional indication for the Whitman or Colonna operation. A very small remnant of the head may also be considered a contraindication for the dowell bone grafting operation, particularly if it is associated with a short neck, as the operation may result in a very marked restriction of motion of the hip joint, even though the bone grafting operation may be successful.

Fortunately, by far the largest proportion of instances of ununited fractures of the femoral neck are those in which the head is viable, and on which there is a small portion of the neck attached. In this group, the selection lies between the dowell bone grafting operation designed to restore anatomical and physiological relation, and the osteotomy employing either the original Lorenz or Schanz procedures, or the McMurray type of operation with the further improvement as recommended by Leadbetter. All of these procedures require immobilization of the operated hip by means of the application of a hip spica.

Despite the fact that a great many very satisfactory results have been reported following the

employment of the high osteotomy, there have been a number of instances in which the operation has been unsuccessful. It may be well to review the causes of these failures:

*Improper selection of the level for the osteotomy*  
If the level has been selected too high, it is difficult to maintain the distal osteotomy fragment under the head and proximal portion of the osteotomy. In some instances the osteotomy has slipped. If the osteotomy has been too low, difficulty may be encountered in maintaining the distal portion of the osteotomy under the head, and union between the head and the distal portion of the osteotomy may not occur. Both these difficulties may well be obviated by the employment of the Leadbetter cervical-axial operation.

*Loss of joint motion.* This may be due to the fact that the ununited head may not have been viable, or to the fact that there may have been early aseptic necrosis, or that osteoarthritis may not have been detected. In these instances restriction of motion may result. The osteotomy appears to stimulate revascularization of the hip joint proper, and osteosynthesis (Wilson).

It has been the writer's experience that in some patients on whom an osteotomy had been performed, and the ununited head had shown questionable viability, later roentgenograms showed definite improvement in the bone density of the femoral head, with consequent union, probably the result of revascularization.

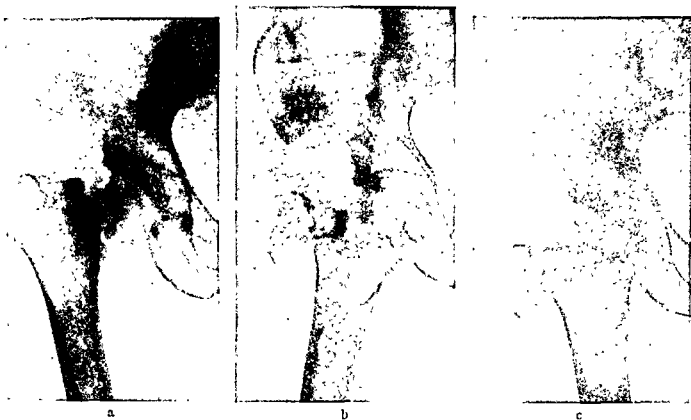


Fig. 3. A, An ununited fracture of the femoral neck of 14 months' duration in a patient 65 years of age. B, Four weeks after operation. Note the high level of the osteotomy, the valgus position with positive thrust, and the moder-

ate degree of abduction. C, Ten weeks after osteotomy the firm and stable position is noteworthy. The patient is bearing weight at this time. (Leadbetter, G. W., *J. Bone Surg.*, 1944, 26: 713.)

The fibrous union between the surfaces of the ununited fracture has become so dense that the fragments have not become separated, thus preventing direct contact between the distal osteotomy surface and the proximal fragment of the neck and head. This difficulty in separating the fragments has been clearly demonstrated in the cervicoaxial procedure of Leadbetter, and must be considered an extremely important advantage in the open operation. It has been proved that the earlier the osteotomy has been performed after the nonunion has been established, the better the end results have been, because of less dense fibrous union. There is another distinct advantage in performing the osteotomy early, and that is that less shortening may have resulted, so that the osteotomy may be done at a higher level.

Blount lays considerable emphasis on the fact that the application of a hip spica cast constitutes a direct hardship to the patient, and recommends fixation of the osteotomized fragments by means of a blade-plate. He also calls attention to the fact that there is resultant stiffness of joints, particularly of the knee joint, following immobilization in a hip spica cast. In his opinion, it is important to fix the osteotomized fragments by

internal fixation in order to prevent slipping, which he states may occur even in a properly applied hip spica. The high oblique osteotomy is the procedure of choice of most orthopedic surgeons; consequently this operation has been performed on a great many individuals, and the hip spica has not been in any way detrimental to the patient's welfare. The operation is so designed that the hip spica does not cause any strain upon the knee joint capsule. In addition, this cast rarely remains applied for longer than a 6 weeks' period, and in many instances only 4 weeks, so that there is very little opportunity for any ill effects to result from its application, either as a debilitating factor, or as a cause of joint stiffness, particularly to the knee joint.

It is needless to say that the application of any type of internal fixation following an osteotomy entails extensive operative technique which cannot help but be shocking to those unfortunate individuals who, in most instances, are not only of advanced age, but have become debilitated because of a long period of disability.

We must not lose sight of the fact that this type of operation, in addition to its very complicated operative technique, involves the use of



Fig. 4. A and B, Anteroposterior and lateral views of right hip show an ununited fracture of the femoral neck of

1 year's duration. The Trendelenburg sign was positive on the right and negative on the left.

a blade-plate, which necessitates, in addition, the insertion of a number of bone screws. All these obviously constitute the application of a number of foreign bodies which are potentially productive of postoperative infection. On the other hand, the high oblique osteotomy is a simple procedure which can be performed in a very short time, with minimal tissue trauma and consequent hemorrhage, and there is no ensuing shock even after the application of the hip spica. The same may be said of the Leadbetter operation, which also can be carried out rapidly, with minimal tissue trauma and hemorrhage, and no shock.

In the opinion of the writer, there is another contraindication to any type of internal fixation following an osteotomy. It has been frequently observed that the distal portion of the osteotomy is apt to wander farther inward under the head and proximal portion of the neck a few days after the osteotomy has been performed, during the process of absorption of the osteotomy surfaces preliminary to osteogenesis. This is due to the pull of the muscle attachments to the lesser trochanter, and constitutes a decided advantage in that the distal portion of the osteotomy rests further under the head and thereby contributes to a more adequate weight-bearing alignment. This obviously cannot occur when the fragments have been locked by internal fixation. Blount

has stated that internal fixation is considered necessary to maintain the position of the fragments of the femur following osteotomy, and thereby prevent slipping. This might well be true for any type of low osteotomy, particularly the Schanz osteotomy, but does not prevail in any high type of osteotomy. It is extremely rare that the osteotomy fragments alter their position after the distal portion has been adequately aligned under the head, and if there is malalignment of the fragments, this condition must be ascribed to faulty operative technique. In the writer's opinion, the only contraindication to a hip spica following an osteotomy would be in the case of an individual with an arthritic knee joint, with impending ankylosis, or in whom such ankylosis may result from prolonged immobilization, in which instance a blade-plate may be indicated.

In comparing the high with the low osteotomy, it is observed that some surgeons prefer the low Schanz osteotomy to the high. The writer believes there are definite disadvantages in the use of the low osteotomy as recommended by Schanz:

1. There is necessarily a greater sacrifice of length because it entails the excision of a wedge-shaped portion of the femur.
2. It requires a greater angle and consequently a longer lever arm both above and below the angle. These features contribute to additional

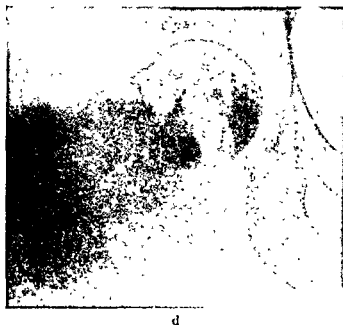


Fig. 4 C and D, Anteroposterior and lateral views of right hip 1 year after osteotomy with blade-plate fixation. (In recent cases an additional screw has been used in the proximal fragment.) The patient began to walk with crutches 8 days after the operation, and left the hospital on the twelfth day. Full weight bearing was possible in 8 weeks. He returned to farm work in 14 weeks. The Trendelenburg sign was negative. (Blount, W. P. *J. Bone Surg.*, 1943, 25: 319.)

shortening. Because of the location of the osteotomy it is more difficult to maintain the osteotomy fragments in position, and for this reason some form of internal fixation is essential.

3. Because of the fact that there is a greater angle at the site of the osteotomy, greater obliquity in the weight-bearing line of the lower extremity, with a greater incidence of knock-knee deformity, must ensue. The knock-knee deformity also occurs in some instances in which the high osteotomy has been performed, but not as frequently as in the low osteotomy. In some instances supracondylar osteotomies have had to be performed secondarily in order to correct the knock-knee deformity.

#### SUMMARY

All individuals with ununited fracture of the neck of the femur may be divided into two groups, and the choice of operative procedure depends upon the group in which the patient may be classified: (1) those patients in whom the ununited head has undergone aseptic necrosis or secondary arthritis; and (2) those patients in whom the head is viable and in whom there is a remnant of the neck attached to the head.

For the first group, the surgeon has a choice of performing an arthrodesis of the hip joint, as recommended by Gill, or of performing the reconstruction operation, as described by Whitman and Colonna. For the second group, in which the head is viable, the condition may be relieved by the Albee bone grafting operation, or a modification of this procedure by the insertion of internal fixation in addition to the bone graft. The alternative is to perform one of the various types of osteotomies that have been recommended. The high oblique osteotomy has proved to be by far the most satisfactory and the simplest procedure to carry out; and the Leadbetter cervical-axial osteotomy has greatly simplified the operative procedure and has completely eliminated the so-called "blindness" in the selection of the site of the osteotomy. The blade-plate fixation of the osteotomy fragments entails an extensive operative procedure no less shocking and difficult than the bone grafting type of correction. The application of the hip spica cast following an osteotomy results in no difficulties to the patient, as it remains applied for a maximum of 6 weeks and the patient may be moved the day following the operation. It may consti-

tute a contraindication in a patient with an arthritic knee, in which instance the application of internal fixation, such as a blade-plate, may be preferable.

The criterion for a good end result has been materially altered since the high oblique osteotomy. Whereas, in the early cases, stable weight-bearing of the hip was considered a good result, now the objective is healing of the nonunion together with the osteotomy surfaces, and painless adequate joint motion, with a minimum of shortening.

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# ABSTRACTS OF CURRENT LITERATURE

## SURGERY OF THE HEAD AND NECK

### HEAD

Dandy, W. E.: Arteriovenous Aneurysms of the Scalp and Face. *Arch. Surg.*, 1946, 52: 1.

Although between 200 and 300 aneurysms of the scalp and face have been reported, they are very rare in the experience of the individual surgeon. Those occurring in the scalp and face are more common than those arising elsewhere in the integument. Nine cases are reported here, including 1 from the clinic of Blalock. Six of the 9 cases reported belong to a rare group in which the primary arteriovenous aneurysm was in the dura and the extracranial aneurysm arose from numerous perforations of the bone from branches of the dural aneurysm. Five of these cases also presented intracerebral aneurysms, as was demonstrated by a right homonymous hemianopsia; the intracerebral aneurysm, in turn, was connected with the middle meningeal arteries, and these were regarded as the point of origin.

The 9 cases were operated on and full case reports are appended with diagrams and illustrations to aid in the understanding of the underlying mechanisms. Only 1 case was considered to be of traumatic origin, the others being regarded as congenital. It was clearly shown in 7 cases that the arteriovenous aneurysm of the scalp derived its arterial component from the middle meningeal artery coming through the skull. These cases can be divided into two groups: (1) in which the preformed genuine arteries come through the skull and enter a primary congenital angiomatous mass, and (2) in which numerous thin-walled vessels penetrate the skull and form an arteriovenous bed without a primary angiomatous mass in the scalp. Both types are likely to derive a bilateral arterial supply from the middle meningeal arteries. In all but 2 cases the aneurysm was in the parieto-occipital region. In 5 cases the right and left middle meningeal arteries were about equally enlarged, and the hemianopsic defect was always unilateral. This was taken to indicate that the intracerebral aneurysm was unilateral as the intracerebral lesion was partly exposed at operation in only 3 cases. The size of the extracranial aneurysm was believed to be inversely proportional to the intracranial.

Headaches, dizziness, noises in the head, and a pulsating mass were the reasons for which the patients presented themselves for medical attention. Only 4 had convulsions but these do not necessarily signify intracranial extension of the aneurysm because other congenital lesions may be present and may be contributory.

The author then summarizes the various methods of surgical treatment. It is said to be doubtful whether ligation of any of the large arteries in the

neck can produce anything but temporary improvement. The exception is, of course, in the aneurysms of the eyelid and face in which ligation of the internal and external carotid arteries on the affected side is indicated. Ligation of the scalp vessels is useless. The intracerebral aneurysm cannot be adequately managed. It is recommended that one or both middle meningeal arteries be tied and that the scalp lesion be attacked directly. Bone flap operations are absolutely contraindicated on account of profuse bleeding from enormous vessels. Removal of bone can be accomplished only piece by piece with the bone biters and the immediate application of large quantities of bone wax. Most of the patients were very much relieved following extirpation. There were no deaths.

This comprehensive article is one of the last of Dandy's voluminous and far reaching contributions to the surgical literature before his untimely recent death.

AUSTIN VEE BRUGGEN, M.D.

Dingman, R. O.: Ankylosis of the Temporomandibular Joint. *Am. J. Orthodont.*, 1946, 52: 120.

The author presents a résumé of the incidence, effects, and pathology of temporomandibular joint ankylosis. The disease itself is quite amenable to surgery, but if it is allowed to go untreated, it interferes with mastication and nutrition, prevents proper oral hygiene, and precludes the possibility of proper dental care. In children it leads to maldevelopment of the mandible with attendant speech defects. Occasionally such disease will have serious consequences in that an acute surgical disease of the mouth or esophagus will be comparatively inaccessible.

The disease is more common in males. It occurs at any age, although usually in a younger individual and more commonly on only one side. Pathologically, true temporomandibular ankylosis is an intra-articular disease which commonly follows trauma or infection. This disease may also be simulated by a false ankylosis due perhaps to scar contractures around the region of the joint, bony tumor, or depressed zygomatic fracture. The pathology is usually much the same, notwithstanding the different etiology. It consists essentially of destruction of the articular surfaces, fibrosis of the capsule and ligaments with subsequent ossification, obliteration of the joint cavity, and joint fixation. It may be due to congenital causes, which in the author's experience were very rare, or mechanical causes, which include fractures, dislocations, chronic osteoarthritis, and suppurative processes in and around the joint (the ear, parotid gland, skull, or mandible); or it may be the result of a metastatic infection. The diagnosis is



generally made on the basis of a long standing history of restricted ability to open the mouth, usually dating from some injury or infection. If the disease starts in youth, generally there is maldevelopment of the lower jaw with a flatness of the face of the uninvolved side. There is a shift of the mandible to the involved side on opening the mouth and some crepitation upon palpation over the joint.

The author suggests anteroposterior and semilateral stereoscopic x-ray studies. In the treatment of these cases surgery is so uniformly successful that it should be resorted to in all cases.

Dilators, exercisers, or instruments for forceful opening are either ineffective or useless.

The author then presents his operative procedure which he does under local anesthesia whenever possible. He closes the operative wound in layers with drainage. Bilateral operation is usually done in two stages with a 4 to 6 weeks' interim.

He believes that the insertion of any type of foreign material, such as metals, acrylics, and heterografts, is to be condemned and that the operative hematoma will give rise to sufficient fibrous tissue in the affected region.

LOUIS T. BYARS, M.D.

**Inclán, A., Jr.:** The Use of Haynes' Maxillary Splint in a Case of Grafting of the Mandible. (Uso de la férula de Haynes en un caso de injerto óseo del maxilar inferior). *Cir. ortop. traumat.*, Habana, 1945, 12: 132.

Since March, 1944 external splinting has been used in the orthopedic service of the author. The Zimmer splint was first used, but, later on, the Haynes splints were employed. At present both types are used and combined according to the requirements of each case. In the case here presented, the Haynes splint was used in the reconstruction operation of the inferior maxilla by bone grafting; the loss of substance was due to a large surgical exeresis of the portion between the symphysis and the angle, which was done elsewhere because of a tumor of the lower jaw. Up to the present time there has been no evidence of recurrence or metastasis.

The Haynes splint is made of screws that are introduced in the bones and connecting bars which fix the screws and permit a high degree of adaptation in various positions.

In the present case it was decided to employ a bone graft 8 cm. long that had been taken from the posterior segment of the 10th rib. Two screws of the splint were introduced into the ascending ramus, 2 in the costal graft, and 2 in the body of the maxilla on the opposite side; all the elements were fixed by means of their connecting bars. No internal fixation, whatsoever, was used and immobilization was maintained for 15 weeks; at the end of this time fusion was present.

The Haynes splint has the advantage of permitting the mastication of soft foods and oral hygiene, both of which are impossible when wires are used to fix the inferior maxilla to the superior one. Furthermore, when the bone defect is of such extent

as the one presented, the Haynes splint permits a degree of fixation which cannot be obtained and maintained by the ordinary methods of fixation.

The clinical history of the patient, corresponding roentgenograms, and details of the operation are given. Fixation by wires on the uninvolved side, to insure good occlusion, was done before the operation. A week after the operation the occlusion wires were removed to permit the mastication of soft foods. Fifteen weeks postoperatively the splint was removed and the graft was firmly fused. The patient has been seen recently (165 days postoperatively); he is in good condition and ready for a dental prosthesis.

F. F. REWY, M.D.

## EYE

**Stone, L. S.:** Return of Vision in Transplanted Adult Salamander Eyes after 7 Days of Refrigeration. *Arch. Ophthalm.*, 1946, 35: 135.

The experimental results of transplanting 70 enucleated, refrigerated salamander eyes are reported. Grafts kept at freezing temperatures eventually degenerated; those kept at 8°C. degenerated if refrigerated longer than 2 days; and those kept at from 4 to 6°C. were successfully transplanted, with functional return of vision demonstrable after refrigeration for 7 days. The corneal tissue was noted to be among the best preserved of the transplanted tissues.

HUNTER H. ROMAINE, M.D.

**Lyle, T. K., Cross, A. G., Simpson, J. F., and Fraser, G. A.:** Dacryocystorhinostomy. *Brit. J. Ophthalm.*, 1946, 30: 102.

Fifty-six cases of dacryocystorhinostomy are reported, including 24 post-traumatic cases. The classical type of surgical technique was followed, being modified, however, to include those cases in which an incomplete excision of the lacrimal sac had previously been done. Contraindications were listed as follows:

- (a) Previous complete excision of the lacrimal sac. (N.B. This can usually be determined only at operation.)
- (b) Destruction of the inferior canaliculus.
- (c) Obstruction of the nasolacrimal duct, due to tuberculosis, malignant neoplasm, and to most of the other causes.
- (d) Atrophic rhinitis.

Of the cases which were followed up, 78 per cent were completely symptom free, 13 per cent were much improved, and 9 per cent showed no improvement.

HUNTER H. ROMAINE, M.D.

**Struble, G. C., and Croll, L. J.:** Removal of Magnetic Foreign Bodies. *Am. J. Ophthalm.*, 1946, 31: 151.

In the removal of magnetic foreign bodies from the eye by the posterior route the authors emphasize the following technical points:

1. Exact localization of the foreign body, especially when it is imbedded in the choroid or retina.

After preliminary x-ray localization a lead marker is attached to the sclera at the point the foreign body is believed to lie and portable x-ray apparatus is used to confirm the position before an incision is made. This somewhat prolongs the operation but the very exact localization thus possible prevents a lateral drag on the choroid or retina, keeps bleeding at a minimum, and reduces the postoperative reaction.

2. Fixation of the globe by scleral silk sutures, one on either side of the incision results in complete control of the operative area, permits traction on the sclera while the incision is made in the sclera, and helps to prevent penetration of the choroid.

3. The sclera is divided layer by layer with a cataract knife and after it is penetrated for about four-fifths of its thickness a catgut suture is placed through each lip for eventual closure of the scleral incision. The incision is then completed down to the uvea without penetration of the latter. It should be about 6 mm. in length.

4. The hand magnet is placed in contact with the uvea and the foreign body removed through it. Foreign bodies less than 0.5 mm. in size may require that a small nick be made in the uvea to facilitate delivery. Larger foreign bodies will pass through the uvea without causing a significant tear.

5. The scleral incision is closed with the catgut sutures previously placed in the sclera.

6. A diathermic barrage is placed around the incision but not penetrating the sclera. Surface coagulation may be substituted.

Experimental studies were made on fresh hogs' eyes to determine the pull of the magnet on foreign bodies placed in the vitreous, and it was found that a pars plana approach for these was satisfactory when the foreign body lay within the "certain" or "critical" zone for the size and weight of the foreign body. Diagrams are submitted for various sized fragments and these are of considerable interest.

WILLIAM A. MANN, M. D.

Friedenwald, J. S., Hughes, W. F. Jr., and Herrmann, H.: Acid Burns of the Eye. *Arch. Ophthalm.*, 1946, 35: 98.

The authors state that acid burns of the eye are more benign than alkali burns. Mild burns recover regardless of the type of treatment; severe burns caused by high concentrations leave opacities, perforation, or symblepharon. Corneal epithelium is highly protective against acids and it has a buffering capacity for solutions below pH 4.0. Isotonic solutions of hydrochloric acid, of 0.005 normal concentration (pH 2.5) or stronger, or exposure to isotonic solutions of citrate-phosphate-borate buffer at pH 4.5 or below, produced ocular lesions.

The severity of the lesion in the cornea by acids is related directly to the protein affinity of the anion. Anions, which have a high protein affinity and protein precipitating ability, produce corneal lesions at a higher pH than anions with low protein affinity, but these large anions (with high protein precipitating

ability) penetrate poorly through the corneal epithelium and diffuse poorly into the stroma. Such precipitation and denaturation of the proteins of the cornea account for the clinical and pathological characteristics of acid burns of the cornea.

JOSHUA ZUCKERMAN, M. D.

Cutler, N. L.: A Basket Type Implant for Use after Enucleation. *Arch. Ophthalm.*, 1946, 35: 71.

A basket type of lucite was inserted into Tenon's capsule in 50 cases of enucleation of the eyeball.

It is the accepted opinion that a more adequately filled socket and a better functioning stump are obtained with any type of implant than without one. The basket implant was devised to provide the socket with a better grip on the prosthesis which has a stud projecting posteriorly, to grip the stump.

The lucite basket, which is fenestrated to allow for the invasion of tissue, measures 11 by 15 mm. There are three holes in the bottom, two of which are for sutures. A lucite button, 5 by 8 mm., with 0.8 mm. holes, is used to tie the sutures through. Three double armed sutures of different colors are used to permit ready identification: black O nylon, blue OO dermal, and purple coarse dermal sutures.

After the conjunctiva is dissected from the limbus and to the fornices in all directions, the rectus muscles are isolated and severed from their insertions. The conjunctival opening is enlarged nasally and temporally about 2 mm., to permit passage of the globe. The globe is grasped with fixation forceps at the tendon of the internal rectus muscle, the nerve is cut, and the prolapsed globe is freed from the oblique muscles and removed.

The basket is then placed in Tenon's capsule and sewed into place by sutures through Tenon's capsule and the conjunctiva.

No attention at all is directed to the re-attachment of the muscles.

Mattress sutures, when pulled up, cause a double imbrication, or folding of Tenon's capsule and the conjunctiva. All the sutures are carried through a lucite stud.

In the prosthesis, the stud is adjusted to fit into the depression, and the base around this stud is cut away to allow the edge of the basket to come forward when the socket is turned.

It is believed that this new type of prosthesis permits more instantaneous movement and a wider range of action.

JOSHUA ZUCKERMAN, M. D.

Cassady, J. V.: Uveal Blastomycosis. *Arch. Ophthalm.*, 1946, 35: 84.

The author reports a case of blastomycosis of the uvea. He points out that there are two types of blastomycosis, cutaneous and systemic, and that the systemic type is fatal in 90 per cent of cases.

In differential diagnosis, the following diseases must be excluded: tuberculosis, coccidioid granuloma, syphilis, sporotrichosis, and bromide or iodine rash. Pathologically, the picture resembles tuberculosis, including the presence of giant cells, but the

double-contoured bodies of blastomycosis are found in sections of the tissue.

A white male, 64 years of age, presented poly-arthritis and discoid, discrete, scaly, elevated lesions of the skin, and severe pain in his right eye. There was a yellowish, tuberclelike nodule in the iris, and total posterior synechiae.

The Mantoux test was negative in a 1 to 1,000 dilution. Roentgenograms of bones revealed irregular areas of destruction (without reaction of the bone around the lesions) and scattered areas of consolidation in both lungs.

Histological examination revealed a dense, opaque lesion of the ciliary body and the filtration angle, exudate in the anterior chamber, anterior and posterior synechiae, and atrophy of the iris. Tubercles were seen in the deep corneal lamellae and around the canal of Schlemm. Double-contoured bodies were present throughout the mass and in the giant cells. The pathological diagnosis was blastomycotic iridocyclitis, cataract, and secondary glaucoma.

From this case of endogenous blastomycosis (Gilchrist's disease), and from other cases reported in the literature, Cassady concludes that metastatic uveitis associated with systemic blastomycosis is not rare. He suggests that if the eye is involved during the course of a fungus infection, the plasmodial intraocular fluid should be withdrawn for cytologic examination and culture.

JOSHUA ZUCKERMAN, M. D.

**Mann, I.: The Intraocular Use of Penicillin. *Brit. J. Ophthalmol.*, 1946, 30: 134.**

The study of the effect of injecting solutions of penicillin (0.15 c.c. of a solution containing from 2,000 to 10,000 units per cubic centimeter) into the anterior chamber of the rabbit's eye yielded some interesting results. The pH of the solutions was 6.5 and all of these solutions were made up in normal saline solution. Almost immediately a coagulum formed on the surface of the iris, which began to shrink in about an hour and tended to disappear in about 4 hours. Corneal edema, conjunctival injection, and cells in the aqueous were noted. Most of this reactive aseptic anterior uveitis cleared up in 3 days, but 1 case did not show recovery for 24 days. It is believed that most of the reaction is due to impurities in the preparation available commercially; but a slight reaction was obtained when a pure sodium penicillinate was used.

In 9 rabbits 1,000 units of penicillin (0.1 c.c.) were injected into the vitreous. This was followed by an immediate localized opacity in the vitreous. From 5 to 7 days after the injection a severe exudative retinochoroiditis ensued. There was retinal and choroidal edema and exudate, edema of the papilla, and pronounced vascular changes with hemorrhage. After the seventh day all eyes but 1 appeared to be blind, with loss of reaction to light. Between the second and third week new vessels appeared from the optic disc and the picture of retinitis proliferans developed. This was combined with complete retinal

and optic atrophy. Subsequently a degenerative iritis and, in some cases, cataract appeared. Histological study of these eyes revealed a complex neuroretinal degeneration followed by fibrosis and accompanied by thickening and fibrosis of the choroid. Further studies were made with practically pure sodium penicillinate. Much less was found in the way of chorioretinal reaction, and all of these eyes showed normal fundi in 3 weeks. Therefore, it appears that the serious results of injecting penicillin into the vitreous of rabbits are due not to the substance itself but to the impurities which are associated with it.

After corroborating the fact that the intravenous injection of penicillin did not result in a high enough concentration in the aqueous to be beneficial in infections of the aqueous or vitreous, a study was made on the persistence of penicillin injected into the aqueous and vitreous of normal and inflamed rabbit eyes. The material was not retained in the aqueous in sufficient strength to be effective more than 6 hours. While it disappears from the vitreous less rapidly, the destructive changes in the eye from injections into the vitreous are so severe that it would seem an unsuitable method. There was no evidence that the inflamed eyes retained the penicillin longer than the normal eyes.

Twenty-nine human eyes with perforating injuries were treated by the intraocular injection of penicillin. They were all eyes which would have been inevitably lost without such treatment. Eleven of the eyes were lost in spite of the penicillin therapy, 9 healed but were blind, 1 eye healed with a cataract, 1 regained 6/36 vision, and 1 had 2/60 vision. Of the remaining eyes, 4 recovered, 1 eye had a malignant melanoma, and 1 was removed because of pain.

It is believed from this experience that intraocular injections of penicillin are justified in severely injured or infected eyes, especially when the infection is confined to the anterior part of the eye and the penicillin does not come in contact with the vitreous.

WILLIAM A. MANN, M.D.

**Summers, T. C.: Penicillin and Vitamin C in the Treatment of Hypopyon Ulcer. *Brit. J. Ophthalmol.*, 1946, 30: 129.**

Nine cases of hypopyon ulcer treated with penicillin locally and vitamin C are reported in detail.

The author has long been enthusiastic in the use of vitamin C given intravenously in daily doses of 500 mgm. The use of penicillin in these cases has impressed him as being very effective. Two hundred units per cubic centimeter were used and one drop was instilled hourly during the day and every three hours at night. In addition, atropine, heat, diathermy, and vitamin C were employed.

The penicillin is apt to cause local irritation after prolonged use and may have to be discontinued. It is suggested that routine carbolicization of all corneal ulcers is not necessary, but curettage of the ulcer before the instillation of penicillin may be advantageous.

The author has the impression that the combined use of vitamin C and penicillin is more effective than the use of either alone, although no statistical evidence of this is presented.

WILLIAM A. MANN, M.D.

**Prendergast, J. J.: Congenital Cataract and Other Anomalies following Rubella in the Mother during Pregnancy; a California Survey.** *Arch. Ophth., Chic., 1946, 35: 39.*

A survey is reported among Californian obstetricians, pediatricians, and ophthalmologists, of congenital defects in infants born to mothers who have had rubella during the first 3 months of pregnancy. It is suggested that transplacental transmission of the virus infection arrests the development of embryological structures in the whole body, and especially in the more important organs such as the eye and the heart, in which organs a high incidence of anomalies is reported. HUNTER H. ROMAINE, M.D.

## EAR

**Korkis, F. B.: Effect of Blast on the Human Ear.** *Brit. M. J., 1946, 1: 198.*

An outline of an Army otologist's views on the incidence, etiology, and types of blast injuries to the ears is given.

The high percentage of associated cochlear trauma in blast ruptures is stressed.

Infection after rupture occurs in approximately half of the cases, and usually begins within 4 days of the injury.

A half-yearly otological examination of soldiers to determine the presence or absence of blast deafness is indicated.

The prognosis is doubtful and should be guarded. Residual deafness may remain.

Routine audiometry upon demobilization is advocated.

JOHN F. DELPH, M.D.

**Lindsay, J. R.: Histological Observations on the Healing of Labyrinthine Fistulas in Monkeys.** *Arch. Otolaryng., Chic., 1946, 43: 37.*

The results which are now available from the first half of this series of fenestration operations on monkeys seem to warrant the following interpretations regarding the regeneration of bone at the fistula:

The fistula in the bony semicircular canal always closes by formation of new bone unless certain measures are carried out.

The regeneration of bone occurs rapidly from the periosteal layer and more slowly from the endosteal surface of the capsule. Complete closure may occur from either or both layers.

Attempts to prevent regeneration of the periosteal bone have resulted as follows:

1. The use of a cutaneous flap reflected from the posterior wall of the external auditory meatus without removal of the annulus tympanicus was not successful. The situation of the fistula in a concavity

tends to prevent close contact with the covering flap throughout the healing period.

2. Thiersch grafts of hair bearing skin were frequently successful in preventing closure for several months, but proved to be unsatisfactory because of occasional degeneration and because of the presence of hair fragments beneath the graft, which stimulated the formation of callus and eventual closure.

3. Conjunctival grafts were used with a sufficient degree of success to warrant further laboratory investigation.

4. The use of a tympanomeatal flap according to the Lempert technique has given the best results, as indicated by the response to the test for fistula. A further report on this series, as well as on the use of a cartilaginous stopple, will be possible when histological preparations are finished.

A factor predisposing to success in the application of any covering graft or flap is the location of the fistula on a convex surface rather than in a localized concavity. Such a site may be obtained slightly distal to the ampulla when the posterior bony wall of the external auditory meatus and the rim of the annulus tympanicus are adequately removed.

The evidence suggests that any fistula remains open only by virtue of the union which occurs between the membranous labyrinth and the covering flap to the exclusion of the osteogenic tissue. The perilymphatic space always becomes separated from the covering flap, either by a layer of new bone or by the membranous labyrinth. Measures necessary to permit fibrous union between the membranous labyrinth and the covering flap have been shown to be:

1. Complete removal of bone fragments and endosteum from the fistula.

2. Preservation of the normal contour and position of the membranous canal, so that it makes uninterrupted contact with the covering flap.

Failure in union was commonly caused by allowing the bone fragments to slip between the bone and the endosteum or between the endosteum and the membranous canal, and by injuring or rupturing the membranous canal so that it became depressed or displaced.

JOHN F. DELPH, M.D.

**Glatt, M. A.: Xanthoma or Lipoid Granuloma of the Temporal Bone (Hand-Christian-Schuller Syndrome).** *Arch. Otolaryng., Chic., 1946, 43: 110.*

A case of xanthoma or lipoid granuloma occurring in the temporal bone of a 36 year old Jewish male is reported. Symptoms of headache in the left temporal region, weakness, giddiness, and tinnitus and impaired hearing on the left side came on gradually over a 5 months' period. The patient's past history was negative except for a healed pulmonary tuberculosis occurring 9 years earlier.

Local examination disclosed redness and bulging of the superior portions of the tympanic membrane and of the anterosuperior wall of the external auditory canal. Conduction deafness of mild degree was present in the affected ear and x-rays showed an

area of destruction of the upper border of the external auditory canal and the anterior contour of the petrous bone.

At operation 3 months later a greenish-brown sequestrum was removed and with it the underlying necrotic dura. The bone surrounding the affected area was irregular and densely sclerotic. Recovery was uneventful. Healing occurred without suppuration.

Histological studies showed large endothelial cells with distinct borders, relatively small vesicular nuclei, and foamy cytoplasm with multinuclear giant cells characteristic of xanthoma or lipid granuloma.

The relation of this solitary xanthoma to the multiple lesions sometimes found in the skull, which may be associated with the Hand-Christian-Schuller syndrome, are discussed. In the presence of a solitary lesion with indefinite borders on x-ray examination, the finding of xanthoma cells in the tissues is necessary for this diagnosis. JOHN R. LINDSAY, M.D.

**Jones, B. S.: Reflections on the Radical Mastoid Operation.** *J. Lar. Otol., Lond.*, 1945, 60: 233.

This article deals with the author's experiences in obtaining complete and permanent resolution of the discharge after a radical mastoid operation has been performed. He believes there is no reason why every patient undergoing a radical mastoid operation should not be freed from any discharge. His experiences are discussed at some length.

NOAH D. FABRICANT, M.D.

## MOUTH

**Desalve, P.: Tumors of the Sublingual Glands (Les tumeurs de la sublinguale).** *Rev. belge sc. med.*, 1942, 14: 178.

Tumors of the sublingual glands are rare. The Anti-Cancer Center of the University of Liege has, since 1925, received only 1 report of such a case.

The patient was a man 46 years old. His father died of cancer, probably of the digestive tract. The patient had had pneumonia in 1920. About 5 weeks prior to the first examination, he noticed an indolent oblong swelling in the floor of the oral cavity; the swelling appeared to grow rather fast. Examination revealed an oblong tumor measuring 3 by 2 cm. on the right side in the floor of the oral cavity, extending from the lingual frenulum toward the second molar. The mucous membrane was elevated and the tumor was found to be slightly adherent to the underlying muscles. Palpation of the right submaxillary region revealed no adenopathy. Diagnosis of a probable mixed tumor of the sublingual gland was made, and excision under local anesthesia was performed and followed by radium treatment. Histologic examination revealed an epithelioma of the salivary gland of cylindromatous type. No evidence of lymph gland metastasis was found. There was no evidence of recurrence for 6 years.

The author found only 17 cases, of sublingual tumors reported in the literature, 14 of which were

classified as mixed tumors. Six of these 14 cases showed local recurrence after surgical excision, and in 2 of these pleuropulmonary metastases also developed.

It is impossible, by histological examination, to differentiate tumors with a benign clinical course from those with very malignant manifestations; therefore all tumors of the sublingual gland should be considered malignant. ARTHUR J. LIESER, M.D.

**Weiss, L. R.: The Control of Bone Fragments in Maxillofacial Surgery.** *J. Oral Surg.*, 1945, 3: 171.

The control of bone fragments in the treatment of fractures of the facial bones is vital. The success of all fracture treatment depends greatly on stability and immobilization.

Reduction and immobilization should be attained by means of the most conservative methods possible for favorable results. There are many methods of fracture reduction and fixation, some having better results in the hands of certain men than in the hands of others. Various methods may be combined and employed together for good end results.

The head bandage has a definite place in first aid or emergency treatment. It affords stabilization to a degree, and gives the patient a sense of security and a feeling that something is being done, although it is replaced by other treatment later.

The use of wire interdentally around the necks of teeth is perhaps the oldest method for jaw fracture fixation. Many methods of wire stabilization have been offered, each with its own merits and its place. The Gilmer type is one of the oldest of present day wiring techniques. From it have been evolved most present day wire fixation methods, in which the upper jaw or the lower jaw is stabilized by its opponent. The Eby-Ivy type of fixation, the Risdon type, and the Stout continuous wire loop all employ the same principles, the purpose of which is to produce lugs or loops by which intermaxillary immobilization may be accomplished, as well as direct fragment fixation. The Stout continuous wire offers a maximum number of stabilization and traction loops and eliminates sharp projecting lugs on the buccal surfaces of the teeth.

The advantages of using interdental wire over the interdental splint are: almost immediate reduction; elimination of impression taking, time consuming laboratory procedures, and the excessive time elapsing between the time of injury and fracture stabilization; and observation of the condition of the teeth at all times, to make sure that the opposing teeth are in direct occlusion with their opponents.

The gauge of wire employed in interdental fixation should not exceed 22, and, preferably, it should be 24 or 25, since unduly heavy wire, in addition to being difficult to handle and more painful to the patient on installation, causes a definite pressure atrophy of alveolar bone, irritates the interdental papillae unnecessarily, and creates a definite gingivitis.

The arch bar attached by interdental wire loops or by tooth bands may be used for stabilization.

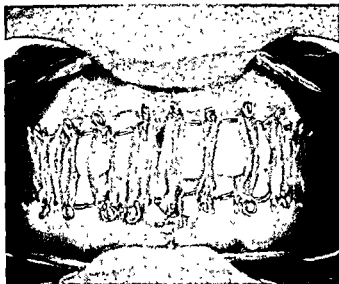


Fig. 1. Interdental wiring with intermaxillary elastic traction; double wiring applied because of ease of installation and added loop rigidity.

Another advantage of these arch bars is that they are rigid enough to withstand considerable traction and distribute an applied force in any direction over a greater area of the dental arch than would be possible with interdental wiring, the lugs themselves offering more rigidity than the ordinary wire loop. The chief disadvantage of arch wires is that their position often produces a pressure gingivitis, since it is hard to maintain them rigidly in their original position, unless the connecting wires are placed in the beginning upon the greatest constriction of the tooth.

Rubber ligature fixation is the most universally indicated and the most adaptable type of fixation. It may be used to accomplish reduction through traction, as well as stabilization. As soon as it has accomplished reduction, its only purpose is stabilization, and it should afford just that. Many fibrous unions following rubber ligature fixation can be attributed to instability, due to the ability of the patient to counteract such traction and produce movement enough to break down the primary blood clot between these fragments. Rubber ligatures in all cases of early fracture fixation should be so strong that the patient may not counteract their traction by voluntary muscular action.

Displacement of bone fragments when the mandible or maxilla is edentulous may be reduced through alveolar wiring of the individual fragments, by the extension of wire through the alveolus of one fragment to another, and by attachment directly to adjacent stable bone, or to a bridging splint or appliance. Direct insertion of wire through the alveolar process of the maxillae to stabilize an upper denture or splint in conjunction with circumferential wiring of the mandible over a denture or splint generally produces good results in edentulous cases.

Intraosseous, intraoral, and extraoral wiring are indicated in fracture of the facial bones when it is

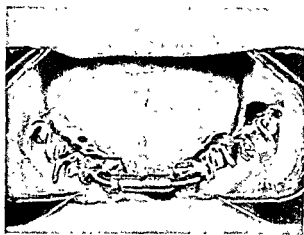


Fig. 2. Cast silver mandibular splint with turn buckle in lower incisor area to align fragments where there is collapse because of bone loss in symphysis area; screw extension to single left molar casting to maintain distal fragment

impossible to maintain these fragments by other methods. This type of wiring is contraindicated in the presence of infection. It is especially applicable in fracture of the orbital ridges, mandible, ramus, and anterior end of the malar bone. Intraosseous wiring of fragments usually should be supplemented by added immobilization of some kind, whatever it may be, for alone it does not give sufficient support. These intraosseous wires may be removed or may remain permanently.

The cemented cast metal cap splint has been used extensively, especially in immobilization of complicated fractures. It is both adaptable and flexible. It may be used solely as a stabilizer, or in combination as a reducing appliance and space maintainer. Numerous connections and appliances may be incorporated in it to produce definite movement of the fragments to any extent or angle.

This type of splint lends itself to the treatment of a great many types of fractures. It may be altered by both intraoral and extraoral extensions. Extraoral extensions may be employed by attachment to

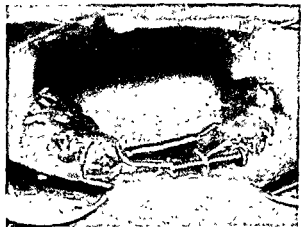


Fig. 3. Adjustable screw attachment used to control inward rotation of fragments; cast silver splint.

## INTERNATIONAL ABSTRACTS OF SURGERY

this type of splint without the use of a headcap. The cast splint is indicated especially for long periods of time and in case the patient may not be under continuous supervision, or when conditions make it necessary for extensive periods of time between treatment. Good oral hygiene may be maintained with little difficulty with these appliances.

The open type of splint made of acrylic or cast metal, locking in the interproximal spaces by projections from a buccal and lingual flange and hinged in the back or in the edentulous spaces with a button attachment for closure and stabilization, is often indicated when all or some of the teeth are affected because of trauma, decay, or periodontoclasia, and as a result are loose and of questionable stability.

The use of external pin fixation has been very much talked about, especially in recent years. External pin fixation has a definite place in fracture reduction and in fixation of the mandible, but it should be used only when there is no other method of obtaining satisfactory reduction and stabilization. It is indicated in cases of extreme loss of osseous tissue in the angle, in the body and angle, in the edentulous jaw, or in the bilateral condyle fracture when the mandible is edentulous.

Intraoral pin fixation has little if any value in reduction and stabilization of any type of fracture with the exception, possibly, of fracture of the angle or of the ramus of the mandible. Its great hazard is the possibility of infection and ensuing loosening of the pins.

Headcap traction as a method of producing stabilization is often indicated, and sometimes offers the only method for stabilization of the part. Attachments, extensions, and fittings of various types may be employed, the resulting traction assuring stabilization or extension in almost any direction or angle. Its stability depends on its covering the external

occipital protuberance and its enveloping the trapezoid process. The plaster headcap, which has stood the test of time, is very adaptable to any desired appliance, but, unfortunately, it is uncomfortable to many patients.

The greater number of fractures coming under the maxillofacial surgery department, being the result of gunshot wounds, show such loss of bone that bridging or approximation cannot be accomplished without loss of function and facial distortion. Statistics from World War I indicate that about 11 per cent of gunshot fractures result in nonunion and require bone grafting. Since, in nearly all of the author's cases, the bone was comminuted and shattered, and often became infected, some necrosis and sequestration resulted. Sequestration can be held to a minimum by early stabilization of the fragments. Immobilization should be secured by splints or appliances stable and rigid enough to withstand all muscle pull and action, as bone grafting requires absolute stability and over a long enough time for the graft to 'take' without disturbance of its position, which must be held by a rigid trouble-free appliance.

No one type of splinting for fragment stabilization in bone graft preparation can be advocated. When teeth are present, the closed cap cast interlocking pin and flange splint furnishes the desired stabilization, being attached by cement to the teeth and otherwise by interdental wires. Bone graft stabilization in the edentulous mandible is a problem that must be met entirely by the ingenuity of the surgeon. It must be accomplished entirely by extraoral fixation either from a headcap, by means of a bar, pin, or wire extensions, or by direct bar or pin fixation, the pins or bar lying far enough from the site of the graft itself not to endanger it from infection, which often results through the communication of bone with the surface of the skin by means of the pin itself.

FREDERICK W. MERRITT, M. D.

# SURGERY OF THE NERVOUS SYSTEM

## PERIPHERAL NERVES

De Girardier, J.: Late Reactions following Nerve Suture with Integral Physiological Restoration of the Nerve (*Dur ôle réflexogène tardif d'une cicatrice de suture nerveuse réussie avec restauration physiologique intégrale du nerf*). *Lyon chir.*, 1945, 40: 33.

A 10 year old girl suffered a deep laceration just above the right elbow which severed the radial nerve and caused typical radial paralysis. The wound was treated 4 hours after its occurrence by careful cleansing and débridement, suture of the nerve ends, and primary closure. The arm was immobilized in a neutral position for 3 weeks, and after 4½ months was functionally as good as the left.

Four years later, however, symptoms suddenly appeared in the right forearm, at first intermittent, but later constant. These consisted of paralysis, paresthesias of the fingers and hand, vasomotor reaction of the skin of the hand and fingers, and a tenderness of that part of the scar directly over the nerve course. Movements of the right hand were decreased, especially wrist extension and finger flexion, and forceful movements were impossible. Finger edema was noted. Examination of the scar showed a slight swelling directly over the nerve trunk, and pressure at this point caused pain which radiated along the posterolateral part of the forearm.

Five months after these symptoms had begun a right stellate injection was performed with immediate relief of all symptoms. An acetylcholine-papaverine mixture was prescribed. Several months later, however, the neuroma again became painful and vasomotor phenomena reappeared. Soon the symptoms became as intense as during the first occurrence. An injection of procaine was made at the neuroma site. This resulted in cessation of the symptoms but the relief was of short duration. It was necessary to give a stellate ganglion injection two more times, but at the time of this report, no symptoms had recurred for more than a year. When and if they reappear, a perihumeral sympathectomy is planned.

A possible relation of the reflex vasomotor reactions and other symptoms to menstruation, since the exacerbation of the symptoms began with the onset of puberty, is suggested.

C. FREDERICK KITTLE, M.D.

## BRAIN AND ITS COVERINGS; CRANIAL NERVES

Munslow, R. A.: Penetrating Head Wounds. *Ann. Surg.*, 1946, 123: 180.

The author reports his experiences with 140 cases of penetrating wounds of the brain divided into 3 groups on the basis of the tactical situation under

which they were treated. The material resulted from the Italian campaign and is presented in a statistical manner.

Ninety per cent of the wounds were caused by shell or mortar fragments and only 5 per cent by small arms fire. Twelve per cent of the patients were admitted in a state of clinical shock, and in 9 of these patients the shock was attributed to the head wound, and in 3, to other associated wounds. Thirty-six per cent of all the patients had also other wounds of the body. Consciousness was preserved in 78 per cent of the patients, although the criteria for consciousness is not defined. Approximately half of the patients had a missile within their craniums upon roentgen examination, the other half had only indriven bone fragments. In 10 per cent of the patients, the paranasal sinuses were injured.

Local procaine infiltration alone of the scalp was used for débridement and repair in 64 per cent of the patients, while intravenous sodium pentothal was used as a supplementary agent in 26 per cent. The average operating time was 1 hour and 40 minutes.

The surgical treatment consisted of débridement and excision of the scalp wounds, the making of a craniectomy for exposure and débridement of the missile tract of all bone fragments, necrotic brain substance, and extraneous material. This was accomplished by use of the suction apparatus under direct vision. The author has not hesitated to use an exploring finger in the brain to search for deeply indriven bone splinters, a procedure which is indispensable if all bone chips are to be found. The author points out that very small metallic missiles within the brain do not present enough hazard of infection to warrant the destruction of brain tissue involved in their extraction.

The missile tracts involved one hemisphere in 70 per cent of the cases and both hemispheres in 21 per cent. Tracts crossing the midline resulted in fatality twice as often as those confined to one hemisphere.

Early in the campaign sulfanilamide was dusted into the débrided cerebral wounds but this was discontinued later. In the last half of the series, 10,000 units of penicillin were instilled into the clean cerebral cavity before closure of the wound. Tight closure of the dura was accomplished in half of the cases and fascia lata grafts were employed when the ventricles had been penetrated.

The sulfonamides were employed in the post-operative management for prophylaxis against invasive infection until penicillin became freely available. Then, 25,000 units were given intramuscularly every 3 hours for 5 days.

There was an operative mortality of 17 per cent. Of 109 soldiers who survived, 103 were observed in follow-up examinations, an unusually good record. Full neurological recovery had been made by most of the patients and 16 per cent had been returned to



duty status. Eighteen patients required secondary craniectomy at the Base Hospitals for various causes, 8 for late abscess.

The author's experiences and conclusions for the most part parallel those of other surgeons who have treated cranial wounds in the combat zones during the war.

LAURENCE M. WEINBERGER, M. D.

Rand, C. W., and Courville, C. B.: Histological Changes in the Brain in Cases of Fatal Injury to the Head. Alterations in the Nerve Cells. *Arch. neur. psychiat.*, 1946, 55: 79.

This article is one of a series dealing with the various cytological changes in the brain following injury to the head. In the total investigation, the authors have been concerned with an explanation, if possible, of the residual symptoms which often persist after head injuries, and with a study of the detailed changes in the various parts of the brain. They found that a generalized chromatolysis of the cortical ganglion cells is the usual response of the brain to severe injury. They assume this to be the histological side of the picture of "commotio cerebri," or concussion, but they do not insist that such changes are necessarily the cause of the change in the psychic realm so often seen in such injured persons. They point out also that "one should not attempt to account for temporary loss of consciousness, with restoration to the normal state in that respect within a few hours, on the basis of alterations in the nerve cells which persist for at least a month, or over."

Following acute trauma, there is a disturbance in the fluid balance of the cerebral tissues, with anatomical alterations within the cells on that basis alone, and it is the combination of the effect of the shock and edema that produce the cellular alterations so consistently seen in the cerebral and cerebellar cortex after acute injury. Local, prolonged pressure upon the cortex, as in a depressed fracture, may produce reversible changes if the pressure is of a moderate degree, and consists of a loss of the tigroid substance and eccentrication of the nucleus. The more severe and prolonged pressure results in local degeneration, due, most likely, to regional anemia rather than to any mechanical effect. Not unless the cortex is actually bruised at the time of depression is such an injury accompanied by any marked degree of change in the cortical cells.

A review is made of the important contributions to the neuronal changes incident to severe destructive lesions of the cortex. These changes are dependent not only upon the original shock, but also upon circulatory deficiency, such as hemorrhage, edema, ischemia, and possibly some local anoxemia. Many of these same conditions exist in other pathological conditions of the brain, but in the instance of traumatic lesions multiple types of change may be found within a single cell.

The authors have evidence to support several conclusions. Cells at the site of trauma may be killed immediately or may die after a variable delay,

according to their degree of direct injury and proximity to the point of greatest force. Cells outside the site of primary injury may survive, or they may, after a period of days, gradually die and fade out. They may show, therefore, either local or general effects of injury. They may live to recover from such changes as loss of tigroid substance or infiltration of hematogenous pigment. Too, some cells may survive but remain worthless to the organism's economy thereafter. Dead and "crippled" cells may become encrusted with iron (ferrugination, "calcification"), and are actually mummy cells in such a state. It is characteristic of the alterations in cells injured by acute trauma that such changes are multiple within each cell. There may be, in the same cell, the so-called "preservation necrosis of Cajal," alterations in the Golgi apparatus, infiltration of pigment, pyknosis, edema and vacuolization, ischemic changes, lipoidal degenerative changes, segmentation of the cell and its membrane, and physicochemical alterations in the cytoplasm. The tigroid substance may undergo profound loss, the neurofibrillae may show marked disintegration, and the cells may become multinucleated. There is one colored plate with the text which beautifully illustrates these various possibilities of cellular alteration.

JOHN MARTIN, M. D.

Echternacht, A. P., and Campbell, J. A.: Midline Anomalies of the Brain; Their Diagnosis by Pneumoencephalography. *Radiology*, 1945, 4: 119.

Congenital cysts of the septum pellucidum and of the associated structure, the cavum vergae, are not of frequent occurrence and are always diagnosed either by pneumoencephalography or by incidental finding in the autopsy specimen. The previous literature contains 15 reported cases of congenital cysts of the septum pellucidum, and the 5 cases of the authors bring the total to 21. These 5 cases were found in a total of 96 pneumoencephalograms, rather a high percentage, which suggested that such developmental anomalies are frequently overlooked in the reading of such roentgenograms.

The cysts which communicate with the true ventricular system (this communication may actually be artifactual) will show with characteristic shadows in the roentgenograms, but those of the noncommunicating type will show only through their "negative" shadow and by the distortion they produce on the surrounding portion of the brain and of the ventricular shadows.

The authors report 2 cases of agenesis of the corpus callosum, a developmental phenomenon sometimes associated with changes in the septum pellucidum. This makes a total of 20 such cases reported to date in the literature.

The midline developmental defects may be associated with mental abnormality, epilepsy of undetermined origin, and other obscure neurological conditions. There is no evidence in any of the reported cases that sex is a determining factor, and the

age of the patients has varied from the time of birth to 73 years.

JOHN MARTIN, M. D.

**Mathewson, W. R.: Meningioma of the Tuberculum Sellae with Bitemporal Hemianopia. *Brit. J. Ophth.*, 1946, 30: 92.**

The author presents a case report of a prechiasmal meningioma with typical early signs and symptoms and progression to partial optic atrophy in both eyes before surgical intervention. Associated bitemporal hemianopic field changes were found in both eyes, being more marked in the right eye in which central vision also was impaired to 6-60.

The field changes in the preoperative phase progressed typically in the temporal halves superiorly, and in the reverse order postoperatively. A method for facilitating the field examination when one eye has lost fixation is described, wherein complementarily colored and green glasses on opposite eyes, a correspondingly colored test object, and a white fixation light are used.

HUNTER H. ROMAINE, M.D.

**List, C. F., and Holt, J. F., and Everett, M.: Lipoma of the Corpus Callosum; A Clinicopathological Study. *Am. J. Roentg.*, 1946, 55: 125.**

The corpus callosum appears to be one of the favorite sites of cerebral lipoma. The world's literature contains 30 cases involving the corpus callosum among a total of approximately 100 known examples of lipoma of the brain.

The authors report a case with a complete history, neurological examination, electrocephalograph, and roentgenograms. This case was operated upon and they give the sequence of events following the operation. A second case is also described and the autopsy findings recorded.

Even though the clinical symptomatology is not pathognomonic, the diagnosis of lipoma of the corpus callosum can occasionally be made during life by roentgenographic means. The roentgenographic signs consist of increased radiolucency of the tumor, calcification, demonstration of an expanding mass in the anterior part of the corpus callosum, and agenesis of the posterior portion of this structure.

Surgical treatment of lipoma of the corpus callosum is contraindicated.

PAUL MERRELL, M. D.

## SPINAL CORD AND ITS COVERINGS

**O'Connell, J. E. A.: The Diagnosis of Lumbar Intervertebral Disc Protrusions. *Brit. M. J.*, 1946, 1: 122.**

Posterior crural, or sciatic, and anterior crural pain are familiar symptoms. In the past the commonly accepted view has been that such pain results from an interstitial neuritis of the sciatic or anterior crural nerves, or that it is referred from lesions of the muscles, ligaments, and joints of the lower back. While the patients with milder cases recover with a variety of treatments based on these etiological hypotheses, the results of such therapy have been

disappointing in the more severely affected patients. During the last 10 years much light has been shed on the etiology of these crural pains by neurosurgeons, led by Mixter (Mixter and Barr in 1934, and Mixter and Ayer in 1935).

Evidence has gradually accumulated to suggest that, at least when the symptoms are severe, their far most common cause is a lumbar intervertebral disc protrusion. The presence of anterior crural or sciatic pain should therefore immediately suggest the possibility that a protrusion of a lumbar intervertebral disc has occurred. This possibility becomes a probability if the leg pain is associated with a characteristic series of physical signs in the lumbar spine and affected lower limb.

A variety of different lesions may occasionally give rise to the syndrome under discussion. The author points out that a tumor within the spinal canal, inflammatory or malignant disease of the spinal column, and spondylolisthesis most commonly cause the described pain. He discusses the importance of a very complete neurological examination and believes that in the majority of cases the extent of a lumbar intervertebral disc protrusion can be discovered by clinical examination alone. Roentgenography usually is the only accessory method of examination that need be routine. The presence of an intervertebral disc protrusion may be revealed by narrowing of the intervertebral interval and perhaps some localized osteoarthritic change. He discusses the use of lumbar puncture with manometry and examination of the cerebrospinal fluid as an aid in differentiating between neoplasms and protrusion of an intervertebral disc.

The author then considers the indications for operation and attempts to give the essential differential points between those lesions which may cause pain. He gives the indications for operation, three aspects being considered: the severity and duration of the symptoms, the severity of the neurological signs, and the severity of the tension signs. He discusses the examination to bring out these features. He stresses that during the neurological examination it is well to remember the anatomy and distribution of the nerves so that one is able to localize the intervertebral disc protrusion and operate at the proper level.

The author states that he bases his observations upon the clinical and operative findings in a personal series of more than 220 proved cases of lumbar intervertebral disc protrusion.

PAUL MERRELL, M. D.

**White, J. C., and Peterson, T. H.: Lumbar Herniations of the Intervertebral Discs; the Value of Surgical Removal for Naval Personnel. *Occup. M.*, 1946, 1: 145.**

Although excision of protruding intervertebral discs should give relief to patients presenting low backache and sciatica, and no additional weakness of the lumbosacral region, such is not always the result. A review of the literature covering 957 cases reveals that the results were classed as from excellent

to good in 67.58 per cent, as improved in 17.08 per cent, and as unsatisfactory in 15.33 per cent. This discrepancy is attributed to changes in the spinal ligaments, articular facets, and laminae which are overlooked even in a careful survey during operation. Relatively few articles concerned with the surgical result of this condition among military personnel have been published. The authors present 39 naval patients operated on with the removal of a definitely herniated disc. Only those who failed to respond to conservative orthopedic management after a month were submitted to surgery. Besides the neurological signs of root compression, a definite filling defect in the pantopaque spinogram was found in all but 2 of the patients. One hundred and one patients with a clinical suggestion of prolapsed intervertebral disc were examined by this method and 56 were returned for nonoperative treatment in the absence of any projection or root sheath filling defect. Two patients were operated upon after normal spinograms were observed because of their definite symptoms, elevated spinal protein, signs of root compression, and failure to respond to conservative orthopedic management. A disc herniation was present in both.

The surgical technique was constant for all operations. Subarachnoid block was the type of anesthesia used. After removal of the muscle from three spinous processes, little or no bone was removed from the contiguous laminae, but extradural removal of the herniated fibrocartilage mass was done. The interspace was then curetted to collect fragments which might subsequently become loose. In each case the adjacent vertebrae were tested for mobility, and the exposed ligaments and articulations were examined for evidence of trauma or malformation, but only one primary spinal fusion was necessitated because of such findings. Postoperative convalescence permitted these men to void while standing on the evening after operation and they were encouraged to sit and move about the next day. Generally in less than 2 weeks, with daily sitting up exercises, these patients were ambulatory. Between 1 and 4 months postoperatively they were discharged to limited or full duty. The ages of the patients varied from 20 to 54 years. Two instances of postoperative sepsis were present but they were not of major import. Some of the patients required catheterization for brief periods. One patient with an unusually large disc had preoperative bladder paralysis, but recovered normal function in 9 days after the operation.

When these patients were admitted to the neurosurgical division it was evident that unless their pain could be alleviated they would require discharge. After operation only 1 has been discharged for medical reasons although the retention in service of 7 others is uncertain. As civilians all of them should be able to do light work and not require total disability pensions. Of 24 patients whose followup extended from 5 to 30 months, 54.2 per cent (13) were classed as having excellent results, 20.8 per cent (5) as having good results, and 20.8 per cent (5) as having uncertain results; and in 4.2 per cent (1) the result

was considered a failure. Therefore, 75 per cent had results both useful to the service and satisfactory to the patients. The remaining 25 per cent is composed of 2 patients who have difficulty in a limited service status, 3 who are hospitalized for further treatment, and 1 patient who is discharged from service but does light civilian work. Of the remaining 15 on whom statistics were available only up to the time of their hospital discharge, 3 were sent directly to duty, and 10 to limited duty or to a naval convalescent unit with a good prognosis. Two had uncertain results. Many men have written subsequently, enthusiastic over their sound physical condition.

Four of the 39 patients had multiple disc herniations. Most of these occurred without a history of additional trauma. There were 3 instances of recurrent pain due to further rupture of the annulus fibrosus and compression of the nerve roots at other sites, and 4 other patients suffered disability after initial successful results. Of these 7 cases, 3 were due to further disc ruptures at other sites, 3 were due to further spinal trauma, and 1 was due to failure to fuse an obviously unstable lumbosacral spine.

During the period when these 39 cases were treated there were 7 other exploratory operations made in which this diagnosis was not substantiated. Hypertrophy of the ligamentum flavum, traumatic swelling of the posterior root ganglion, and neurofibroma of the cauda equina were lesions which had caused filling defects on the spinogram and presented a clinical history suggesting ruptured intervertebral disc.

The authors believed that primary spinal fusion was indicated only when structural defects in the vertebrae are obvious. All ligaments, laminae, and articular facets exposed should be critically examined during the operation with this orthopedic aspect in mind. Indications for fusion are those suggested by Ghormley, Love, and Young: spondylolithesis, spondylolysis, extensive lumbosacral arthritis or buckache of the static type, congenital anomalies such as abnormal sacralization of the lowest lumbar vertebrae, and abnormalities of the neural arch or of the vertebral body, with apparent instability of the vertebra at the time of operation. The history is significant in that only those patients who are relieved by rest and have pain on activity are suitable candidates for fusion. In this series 1 primary fusion and 2 secondary fusions, for later herniations, were done.

The relatively high rate of good results is attributed to the care with which the operative patients were selected. Only those with filling defects and failure to respond to orthopedic care were submitted to operation.

C. FREDERICK KITTLE, M.D.

#### SYMPATHETIC NERVES

Tyson, M. D., and Gaynor, J. S.: Interruption of the Sympathetic Nervous System in Relation to Trauma. *Surgery*, 1946, 19: 167.

Interruption of the sympathetic nervous system applies chiefly in 3 general categories, in all of which it

is used to improve the circulation at the site of the trauma. These groups are as follows:

(1) Post-traumatic painful and vasospastic states, with or without Sudeck's osteoporosis. This group includes those cases in which reconstructive surgery is contemplated in the face of a dangerously reduced circulation.

(2) Injury of the main arterial supply of an extremity.

(3) Acute trauma, particularly fractures and crushing injuries to the hands and feet.

Cases demonstrating all of these groups are discussed.

The authors conclude that cases of these types should first have a novocain block to see whether any improvement results. If there is marked improvement which disappears after the effects of the novocain wears off, and the condition is sufficiently serious, permanent interruption of the sympathectomy fibers is indicated. It is believed that this may result in marked reduction of the disability, pain, and period of hospitalization. JOHN W. EPRON, M.D.

Peet, M. M., and Isberg, E. M.: Surgery for Hypertension. *J. Am. M. Ass.*, 1946, 130: 467.

Between the dates of November, 1933, and September, 1945, more than 1,500 patients received surgical treatment for hypertension at the University Hospital at Ann Arbor, Michigan. The operations consisted of bilateral supradiaphragmatic splanchnicectomy and lower dorsal sympathetic ganglionectomy. Of these patients, 437 with essential hypertension were followed up for from 5 to 12 years after surgery, and 57.5 per cent are living from 5 to 11 years after surgery. Eighty-two per cent of the patients had serious organic disease prior to the operation, but 95 per cent of the hypertensive patients who showed no signs of cardiac, cerebral, or renal involvement before the operation are living from 5 to 11 years after surgery. A third of all patients who manifested preoperative disease of the heart, brain, or kidneys did not survive the 5 to 11 year period.

It is pointed out that a complete clinical profile of the patient must be obtained before surgery is undertaken, since it is never an easy task to determine just what patient will benefit by surgery or survive long enough to make the procedure worth while. This profile consisted of studies for renal function and cardiac efficiency, fundoscopic examination, frequent blood pressure recordings, and detailed physical examinations and careful history taking. Favorable changes in the drop in blood pressure with resultant improvement in the subjective complaints of the patients, significant improvement in kidney function, and protection against repeated cerebral vascular accidents in those patients who had had such complications, have been found to be the result of surgery in a gratifying number of patients. For these reasons the authors believe that the life span of the hypertensive patient may be significantly lengthened by surgical treat-

ment, although it is admitted that the "hypertensive predisposition" always persists following surgical treatment, regardless of the fall of the blood pressure to normal levels, and that no claim should be made that essential hypertension is cured by splanchnicectomy.

JOHN MARTIN, M. D.

## MISCELLANEOUS

Houston, H. E.: The Neurosurgical Service in an Evacuation Hospital. *Bull. U.S. Army Med. Dept.*, 1946, 5: 328.

This is a report on the neurosurgical cases seen in an Army evacuation hospital. Of 1,393 cases cared for on the neurosurgical service, 406 were considered closed head injuries. Approximately 80 per cent were the result of blast and in the remainder the head of the patient had struck or had been struck by some object. No differentiation was made in the two types of injury as it was believed that the less severe blast cases behaved much like concussions from direct force. The more severe ones resembled basilar skull fractures. The chief difference seemed to be the associated ear and lung damage in the blast variety. There were 14 deaths in this group. All of the patients had been admitted while profoundly unconscious, with no localizing signs. No therapy seemed of value in these serious cases and they deteriorated. Autopsy in 2 cases revealed multiple petechial hemorrhages in one and ventricular hemorrhage in the other. Two patients were explored for suspected subdural hematoma with negative results.

Scalp lacerations were treated by conservative débridement and closure of the galea and skin layers with interrupted silk.

Simple fractures were treated as the closed head injuries, but the compound fractures were debrided and closed. Penicillin and sulfadiazine were administered for 4 days or longer. With compound depressed fractures, the depressed area was approached through a burr hole in the normal skull, the entire involved area excised, and the dura closed with silk if opened.

Of 271 patients with penetrating brain injuries, 69 died without surgery. The treatment of shock was given priority over operative care in this group. Less than 50 per cent required shock treatment of some sort and only 10 per cent required intensive shock treatment. Barbiturates and morphine were used to control restlessness and no untoward effects were noted from the use of morphine. The optimum time for surgery appeared to be between 18 and 24 hours following the injury. The single exception to such delay in surgery was in the case of ventricular wounds: these cases deteriorated rapidly if not subjected to surgery. Penicillin and sulfadiazine were employed, and preoperative medication consisted of 3 gr. of sodium amytal,  $\frac{1}{4}$  gr. of morphine, and 1/150 gr. of atropine. The anesthetic agents included pentothal sodium, intratracheal gas-oxygen-ether, and novocain. In at least 85 per cent of the cases pentothal sodium was used. The primary wound was de-

brided and extended in a linear manner, and the bone around the wound removed to secure a normal dural margin of  $\frac{1}{4}$  inch. Necrotic brain and hematomas were removed with suction. Bone fragments and foreign bodies were removed under direct vision when practicable. Finger exploration was carried out if space permitted, and, finally, the tract was irrigated, a catheter being used if the ventricles were involved. If possible the dura was closed with interrupted silk; if not, the defect was closed with a detached pericranial or galeal graft. The galea and skin were closed with interrupted silk sutures, penicillin and sulfanilamide powder being placed in all of the wounds. If the scalp defect could not be closed, a flap extending down to the periosteum was mobilized and advanced to close the bone defect completely. Wounds involving the paranasal sinuses were treated similarly, except that exenteration of the sinuses was carried out. Dural closure or graft and skin closure seemed particularly important in this group. The head dressing of choice was an unpadded plaster cast.

The prognosis in the cases with ventricular damage was very poor; 12 of the 18 deaths among 201 cases operated on were in this group. The postoperative care consisted of the continuation of penicillin, sulfonamides, and crystalloids, and plasma and blood as indicated. Diet and activity were allowed as

tolerated. Patients were evacuated as soon as they were oriented, taking food well, and relatively afebrile. The average postoperative stay was from 4 to 6 days.

Of 85 patients admitted with injuries of the spinal cord or cauda equina, 37 were admitted with associated wounds of the chest or abdomen. The latter injuries were given priority in the treatment. Nine laminectomies were done because of nontransportability to a neurosurgical center. Twelve cases presented complete transection of the cord above the level of the third dorsal segment. Immediately on admission, these patients were given indwelling catheters, x-rayed, and transferred to a well padded litter. If evacuable, they were given highest priority to a neurosurgical center. The prone position was favored in lower lumbar and dorsal injuries, and the recumbent position in upper dorsal and cervical injuries. Casts were employed only for those with an unstable vertebral column. Patients having laminectomies were premedicated with sodium amytal, morphine, and atropine. The operation was as limited as possible. The metallic and bony fragments were removed, the dura closed with silk or with a fascial graft. Complete closure of the soft tissues was carried out. Evacuation was carried out in from 4 to 6 days.

JOHN W. EPTON, M.D.

# SURGERY OF THE THORAX

## CHEST WALL AND BREAST

Campbell, O. J.: *The Bleeding Nipple. Surgery*, 1946, 19: 40.

The significance of a discharge from the nipple, particularly a bloody discharge, has been variously interpreted. Some workers have found about the same proportion of benign and malignant lesions responsible for this symptom.

Undoubtedly the difficulty in distinguishing between actively proliferating adenocystic disease and cancer has complicated the problem of determining the true incidence of malignancy in patients with a bloody discharge. Sanguineous discharge from the nipple is not a common symptom.

It has been shown that duct papilloma, carcinoma, and cystic disease are responsible for most of the cases of bloody discharge from the nipple. Other etiological factors, however, are inflammatory lesions, traumatic lesions, hormonal dysfunction, sarcoma, and Paget's disease.

The character of the discharge is merely suggestive, but all types of discharge (with the exception of galactorrhea) need investigation.

Diagnosis is essentially a problem for the pathologist. Frozen sections are not to be relied upon. Because cancers associated with bleeding from the nipple are usually of low malignancy and also because the differentiation between cancer and adenocystic disease may be difficult, the surgeon should permit the pathologist time to prepare and study permanent slides.

In the absence of palpable tumor there are three diagnostic aids for the localization of the source of bleeding: (1) transillumination, (2) mammography, and (3) pressure tests.

Suggested treatment procedures consider the following:

A. Discharge and palpable tumor. The presence of the tumor alone is sufficient justification for its removal. Local excision may suffice for solitary intraductal papillomas and well localized adenocystic disease, but because the sources of bleeding may be multiple it is better practice to excise the entire duct and tributary glands. Only when the pathologist has satisfied himself that the lesion is malignant is radical amputation justified.

B. Discharge and diffuse nodularity. A segmental resection of the duct containing the bloody discharge and its tributary system is done. If cancer is not found and the source of bleeding is eliminated the attitude toward the remaining breast will depend upon the surgeon's attitude toward cystic disease as a potentially precancerous lesion.

C. Discharge and no palpable tumor or demonstrable breast change. Whenever the source of bleeding can be located the offending duct and tributary glands are excised. When the discharge

is intermittent or scanty it may be difficult to locate the segment of breast or the duct from which the discharge is coming. Under these circumstances it seems entirely reasonable to keep the patient under observation. Repeated examinations will usually permit localization. The justification for this policy is based upon the extreme rarity of sanguineous discharge from the nipple caused by cancer and without palpable tumor.

D. Bloody discharge from multiple sources. A waiting policy is here indicated unless palpation reveals changes in breast consistency which then justify biopsy of the most suspicious area. Bleeding of such nature may subside spontaneously.

E. Pseudosanguineous discharge. A dark green, sometimes grumose discharge from the nipple may easily be mistaken for bloody discharge. When a single duct is the source, excision is warranted for the patient's peace of mind. The excised duct will show ectasis only. There will be little or no sign of epithelial activity. The dilatation may involve even the smaller tributary ducts in the periphery of the breast. When multiple ducts are involved and no masses except the ducts themselves are palpable, the condition need not be disturbed since sacrifice of the whole breast is unnecessary.

F. Persistent or nonlocalized bleeding. Persistent bleeding from multiple sources or bleeding which cannot be localized may warrant simple amputation. Especially is this true in older women in whom the loss of the breast is not a tragedy, or when the patient herself may elect to end her state of uncertainty or apprehension. STEPHEN A. ZIEMAN, M.D.

Costello, C. J.: *Breast Cancer and "Paget's Disease of the Breast."* *Arch. Surg.*, 1945, 51: 262.

This study, which has been prompted by the evidence of confusion and the divergence of opinion among clinicians and pathologists alike as to the nature of so-called Paget's disease of the breast, embraces a thorough review of 29 cases as well as a review of the studies and observations by other investigators of this malady. The origin of the dissection emanates from confusion in regard to the cause and significance of, and consequently the therapy indicated for, Paget's disease.

What has been called "Paget's disease of the breast" begins as an intractable eczema of the nipple or areola. The patient's first recollection of the onset is an often recurring pruritis of the skin in this region. Again, the first symptom may be a simple crust associated with weeping or even bleeding of a minor character when it is removed. In some instances the first bleeding is noted to come from the summit of the nipple, although this may not correspond with the center of the cutaneous lesion.

Certain resemblances exist between Bowen's and Paget's diseases. Generally, Bowen's disease is con-

sidered to be a primary epithelial malignant growth of low grade and slow progression. The chief distinguishing feature is that in Paget's disease there is actual dissociation of the abnormal cell, whereas in Bowen's disease the cell continuity with the adjacent epidermal cells is retained and the intercellular bridges in the rete malpighii are preserved.

Paget cells appear to be metastatic cancer cells. The origin of Paget cells may be from breast carcinoma, epithelioma, rectal adenocarcinoma, apocrine sweat gland carcinoma, or other tumors.

In order to insure earlier recognition, refractory eczematoid lesions of the breast should be subjected to biopsy. The mode of extension may be by direct extension, retrograde lymphatic continuity, or ductal spread.

In order to reduce confusion among pathologists and clinicians and in order to facilitate earlier and more rational therapy, the eponymic nomenclature, "Paget's disease of the breast" and "extramammary Paget's disease," should be abandoned; "secondary epidermal carcinoma" is suggested as preferable.

Treatment of secondary epidermal carcinoma must proceed along the lines of rational elimination of the primary carcinoma as well as of the cutaneous lesion. In order to insure a higher curability rate, treatment for secondary epidermal carcinoma of the breast must include radical mastectomy, whether the primary site can be detected by palpation or not.

JOHN E. KIRKPATRICK, M.D.

**Oberhelman, H. A.: Diagnosis and Treatment of Carcinoma of the Female Breast. *Surg., Clin. N. America*, 1946, 26: 116**

Pain is not a diagnostic sign of carcinoma of the breast. In one series of 1,040 cases, only 1.6 per cent of the patients came to their doctor because of pain. In only 3 per cent of 500 cases of carcinoma of the breast were there more than one nodule. The author believes that so called borderline or precancerous lesions, which occur almost exclusively in the proliferative and hyperplastic form of fibrocystic disease, call for radical surgery. It should be remembered that carcinoma can develop in accessory breasts; 2 per cent of all mammary carcinomas develop in women under 30 years of age.

The author follows the operative technique of Adair, by which the pectoralis fascia is removed but the pectoral muscles are preserved. Postoperative radiation therapy is used. Local recurrence is treated by local excision of the tumor mass followed by vigorous irradiation. Sometimes in these cases irradiation alone is used.

EARL O. LATIMER, M.D.

**White, W. C.: The Problem of Local Recurrence after Radical Mastectomy for Carcinoma. *Surgery*, 1946, 19: 149.**

The author reports 22.6 per cent of local recurrences among 238 cases of carcinoma of the breast. The patients were observed for a minimum of 5 years. This rate of recurrence compares favorably with statistics from other clinics.

The percentage of local recurrence in cases with axillary involvement was tripled over that in cases with cancer limited to the breast.

The rate of local recurrence was essentially the same if a wide excision of the skin was done and the defect covered with a skin graft, or if a plastic closure was done by removing a circular diameter of about 5 inches of skin (Handley technique) and effecting a plastic closure of the defect by means of dissection of the subcutaneous tissue of the remaining skin.

In the author's experience postoperative irradiation did not reduce the incidence of local recurrence

EARL O. LATIMER, M.D.

## TRACHEA, LUNGS, AND PLEURA

**Johnson, J.: Battle Wounds of the Thoracic Cavity. *Ann. Surg.*, 1946, 123: 321.**

This article presents the experiences encountered in North Burma from December, 1943 to March, 1945. Three hundred and eight patients were treated in the General Hospital for wounds of the thoracic cavity; of these, 6 were due to bayoneting, 153 to bullets, and 149 to fragmentation missiles. The patients were predominantly Chinese. At least 60 per cent of them were received within 36 hours after wounding, although some were received after 3 or more weeks.

The initial treatment was carried out in portable surgical hospitals under primitive circumstances. The management was conservative in the main, essentially débridement and closure of the chest wall with only an occasional intrapleural procedure. The work of the forward units was highly commended. Evacuation was largely by air.

The patients requiring emergency treatment on arrival at the base were those with (1) blood loss and shock, (2) disturbance of the mechanism of respiration, or (3) combinations of these.

There were 140 hemothoraces or hemopneumothoraces; 103 were treated by thoracentesis. The small number left untreated required a long hospital stay or developed thoracic disability. If infection occurred in these cases, the empyema was larger than if aspiration had been done. Air replacement is recommended. Recurrence of the pulmonary bleeding did not occur as a result of thoracentesis. Fever was frequently present, but persisted only in the infected cases. Infection in the underlying lung may account for this phenomenon. Clotting, or the loculation of pleural fluid from other cause, occurred in 8 per cent (11 patients). Eight of these 11 patients were infected. Only 1 patient was subjected to decortication, and from experiences gained earlier in the campaign, this is the recommended treatment.

Tension pneumothorax was treated by repeated thoracenteses or catheter decompression if the rapidity of the reaccumulation of air justified this. After 4 or 5 days, negative pressure may be added to the water-seal to promote pulmonary expansion. There were 50 patients who had sufficient shift of the

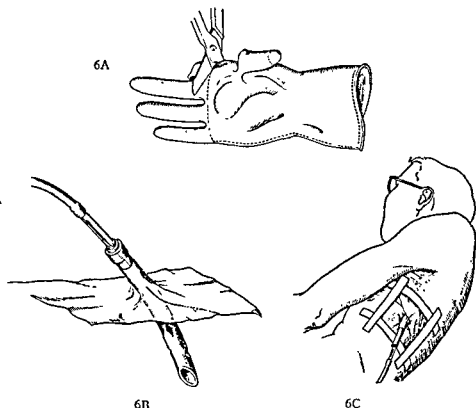


Fig. 1. Method of applying suction to an open thoracostomy. A. The fingers but not the thumb are cut from a rubber glove. The tip of the thumb is cut away. The glove is then cut along the ulnar aspect. This will then open to form a sheet of rubber tissue with the thumb in the center. B. A large rubber tube is then put through the thumb and glued to it. The tube is connected with an ordinary three bottle Wangenstein suction apparatus. C. The skin around the empyema opening is painted with the glue used with the Padgett dermatome for removing skin grafts. A little gauze packing is placed around the tube to absorb any ex-

cessive fluid until the rubber tissue is stuck. The rubber tissue is then held moderately taut and placed down smoothly on the skin surface. The tube must already be connected to the suction apparatus so that suction can be applied immediately. This will pull the rubber tissue tightly against the skin surface so that it may become effectively glued. The edges of the rubber tissue are covered with adhesive. When carefully applied this air tight seal is effective for from 10 to 14 days. With the Wangenstein suction apparatus a negative pressure of up to 150 cm. of water can be attained. (Courtesy of J. B. Lippincott Co.)

mediastinal structures to be diagnosed upon clinical examination.

Subcutaneous emphysema was seen in 29 patients. In only 2 was it massive. Relief of a tension pneumothorax corrected this in 1 patient. The other, having a wound of the trachea, low in the neck, required a tracheotomy to prevent expulsion of air into the tissues on coughing. This management for certain types of tracheal wounds is discussed and recommended.

Lung wounds were treated conservatively. In only 2 instances did lung abscess develop and both of the patients died as a result of multiple abscesses. Rather rapid clearing of the lung hematoma was a common experience.

The fundamental objective in the treatment of empyema is to obtain adequate drainage and achieve re-expansion of the lung as rapidly as possible. Earlier in the campaign, aspiration over a period of time sufficient to allow for fixation of the lung to the chest wall was undertaken to prevent a total pneumothorax when rib resection drainage was done. This, however, as well as intercostal drainage, was

interfered with by difficulty in accommodating the heavy exudate to the lumina provided. Later, therefore, drainage was undertaken much earlier when, under intratracheal anesthesia, a large sized opening was made in the chest by removing the segments of two ribs and intervening muscle. All the exudate was then removed and closed drainage with suction to 150 cm. of water (achieved by a Wangenstein apparatus) was applied, according to the method illustrated. Suction was continued until the cavity was reduced to very small size (5 c.c. or less).

The incidence of empyema was 9.7 per cent, or 30 cases. Five per cent of the bullet wounds, 10 per cent of the shell fragment wounds, and 66 per cent of the bayonet wounds developed empyema. The absence of any case of infection by the hemolytic streptococcus was thought to attest to the value of the use of sulfonamides. Organisms of the salmonella group were found in 3 cases. Four types of empyema are discussed:

1. Infection in a simple hemothorax—16 patients presented this type. They were managed by the principles outlined previously.



2. Infection in a clotted hemothorax (8 patients). These patients were managed in similar fashion, although the earlier the operation was performed the better the outcome. One case came to decortication. One patient with a cavity of 1,200 c.c. capacity, had suction applied 6 weeks after the original injury. In 17 days the cavity measured 50 c.c.

3. Putrid empyema, in 3 patients. These patients differed from those of Type I chiefly in the virulence of their infection. They were subjected to emergency operation and treated by airtight seal and suction.

4. Infected open sucking wounds, in 3 patients. In addition to the infection, these patients had disturbances in respiration. They were treated either by sealing the wound and providing drainage or by drainage through the wound, all of which was sealed.

There were no deaths among the 30 patients with empyema. Complete re-expansion of the lung was obtained in all but 2 patients. These had been treated conservatively, until recrudescence of fever brought about the demonstration of infection, presumably rupturing from the underlying lung into the hemothorax. The cavities were greatly reduced and both were closed by a Schede procedure.

There were 61 patients with retained missiles (7 bullets and 54 shell fragments). These did not seem important in the production of empyema. In no instance was it definitely demonstrated that the foreign body produced a typical putrid lung abscess, spontaneous drainage into the pleura was believed to have been seen, however. Only 1 patient had a massive pulmonary hemorrhage. Foreign bodies larger than from 1 to 1.5 cm. in size were generally removed; 23 of the 61 foreign bodies were removed. Two foreign bodies were associated with a putrid empyema in which operation was done as an emergency; 1 foreign body was removed from the pericardial sac because of effusion with tamponade and cardiac failure, 1 from the free pleural space because of persistent effusion, and 1 from the mediastinum, close to a large vessel, and 18 foreign bodies were removed from the lung more or less electively. The patients were allowed to recover as completely as possible from not only the lung wound but any pleural complication before removal was undertaken. The details of the operative approach are given. In 1 case a pure culture of clostridium welchii was obtained from the cavity around the foreign body, but no complications occurred. No significant complications were encountered, and all of the patients returned to duty.

There were 4 patients who had recognizable wounds of the heart or pericardium. One had a perforation of his left ventricle, left lung and spleen. Although his wounds were repaired, he died. Another had a slow tamponade due to shell fragment lodged in the posterior pericardial sac. Two cases of pericarditis were seen following wounds. These 3 patients were successfully treated.

There were 46 thoracoabdominal wounds. The mortality in this group was 20 per cent, or 9 patients. Only 1 patient died as a result of a chest wound.

The total number of deaths in this series of 303 patients, regardless of the associated injuries or diseases, and regardless of the cause of death, was 21, a mortality of 7.4 per cent. Twelve of these patients had insignificant chest wounds. Only 6 patients, 1 per cent of the total series, died primarily of their chest wounds. The cause of death in these 6 was (1) a sucking wound that had persisted for 48 hours without treatment (the patient died 3 hours after being seen); (2) perforating wound of the heart, lung, and spleen; (3) cerebral air embolism (2 cases, 1 proved by autopsy); and (4) multiple lung abscesses (1 cases).

Numerous illustrative roentgenograms, as well as a photograph, are appended.

HIRAM T. LANGSTON, M.D.

Klosk, E., Bernstein, A., and Parsonnet, A. E.: Cystic Disease of the Lung. *Ann. Int. M.*, 1945, 24: 217.

Cystic disease of the lung is found in the course of routine physical and roentgen examinations since it rarely gives symptoms. The authors review the literature and report a series of 13 cases at the Beth Israel Hospital, Newark, New Jersey, discussing specifically the complications of this disease.

Cystic disease of the lung is defined as any condition in which the lung parenchyma is replaced by sharply defined cavities containing fluid or air. Dermoid cysts of the lung, echinococcus cysts, and encapsulated interlobar accumulations of fluid or air are excluded. Cystic disease may be congenital or acquired, or both, with the prevalent opinion leaning toward the congenital origin.

Clinically and pathologically, congenital cystic disease falls into two groups: (1) the large solitary cyst usually found in infancy and early childhood which displaces the heart and mediastinum and gives symptoms of cyanosis and dyspnea, and physical signs of tension pneumothorax; and (2) degeneration of the lung parenchyma by multiple millary cysts or large multilocular or unilocular cysts. Acquired pneumatocele or pneumocyst is usually associated with respiratory infection, chronic bronchitis or peribronchitis, pulmonary fibrosis, and emphysema or bronchial asthma.

The solitary cysts are lined by a layer of columnar and cuboidal epithelium resting on a tunica propria and a layer of connective tissue. The cavities in the cystic degeneration are similarly lined but the epithelium may be thrown into folds by intraluminal proliferation with an adenomatous appearance. Clusters of thin walled cavities communicating freely with the bronchi are lined with columnar ciliated or nonciliated epithelium. The contiguous alveolar walls in the presence of pneumatoceles or pneumocysts from bullous emphysema are encrusted with coal pigment.

Roentgenographically, an acquired pneumatocele may be indistinguishable from the congenital form, although one suspects the acquired form when the lesion is seen in an adult.

Roentgenographically, solitary cysts appear as large areas of radiolucency which may or may not contain fluid. They may be so ballooned out with highly positive intraluminal pressure as to resemble tension pneumothorax.

The second form of cystic disease is characterized by the honeycombed appearance of the pulmonary fields with thin walled, sharply defined annular shadows without accompanying interstitial parenchymal infiltration. Direct communication with the bronchus can be confirmed by bronchography on the finding of cystic spaces in grapelike clusters.

Complications of the disease are common and some of them bring the patient to the doctor. Upper respiratory infections are very often followed by infection in the cystic areas with episodes of pneumonia, without, however, the severe constitutional symptoms associated with acquired bronchiectasis, nor the cerebral manifestations associated with pulmonary suppuration. Cardiorespiratory reserve diminishes with age with increasing dyspnea and sometimes death from failure of the right side of the heart. The most frequent complication is hemorrhage, seldom profuse, but varying from slight hemoptysis to exsanguinating proportions: its true source has not been established.

The case reports describing the complications are given in the following order of frequency: (1) fluid filled cystic disease (1 case), (2) cystic disease complicated by hemorrhage (4 cases), (3) cases complicated by infection (2 cases), (4) cases complicated by spontaneous pneumothorax and hemopneumothorax (2 cases), and (5) acquired cystic disease (3 cases).

LYNN JOHNSEN, M.D.

**Fattl, L., and Others: Acutely Infected Pleural Effusions; Techniques of Penicillin Treatment.**  
*Lancet*, Lond., 1946, 1: 295.

The authors used various techniques in administering penicillin in the treatment of 24 acutely infected pleural effusions—in 14 while the pneumonic symptoms were still present and in 10 after this phase subsided. The success or failure of these techniques was determined by comparing the results with a series of 14 controls treated along well accepted lines. The duration of illness both from the earliest pneumonic symptoms and from drainage until full healing of the controls was 15 and 11.5 weeks, respectively. Any penicillin treated case taking as long as this full healing was considered a failure. Treatment was successful only when the duration was less than the shortest time taken by any of the controls—8.5 weeks from the earliest pneumonic symptom and 5 weeks from drainage.

Seven cases were treated by aspiration followed by the injection of penicillin. The organisms were the pneumococcus in 2 cases, the staphylococcus in 2, and the streptococcus in 3 cases. The results were success in 2 cases, partial success in 1 case, and failure in 4 cases. The successes occurred in cases with interlobar collections of not more than 2 ounces. One death occurred in this group. The failures oc-

curred in cases of extensive empyema in which the original thin fluid thickened so that aspiration was almost impossible. Three of these cases were treated later by rib resection. This method was abandoned early in the series except for small interlobar effusions which could be completely emptied by aspiration.

Three cases were treated by rib resection, all of which were considered failures as they healed in about the same time as the controls. Two cases were due to the hemolytic streptococcus and 1 was due to the anaerobic streptococcus. All 3 cases became secondarily infected with the staphylococcus aureus. This method of treatment was abandoned when it was realized how badly these cases were progressing compared with the others treated by the methods subsequently described.

Ten cases were treated by intercostal drainage and the instillation of penicillin with success in 7, partial success in 3, and failure in 1 case. There were 7 pneumococcal, 2 staphylococcal, and 1 anaerobic streptococcal cases. The intercostal tube was alternately used for drainage and the instillation of penicillin. The only failure resulted from faulty technique in draining a multiloculated empyema from one loculus only. Rib resection was eventually carried out. All these cases healed in from 6 to 7.5 weeks from the first symptoms and from 2 to 4.5 weeks from drainage. This method was most suitable for localized empyema, as the risk of lung collapse was slight and the emptying of the cavity was far more effective than aspiration once the exudate thickened.

Eight cases were treated by aspirations and injections, with subsequent intercostal drainage. There were 6 pneumococcal infections, 1 staphylococcal infection, and 1 pneumococcal infection, but no hemolytic streptococcal cases. Aspirations and injections were carried out for a preliminary period followed by an intercostal drain when the exudate thickened. These cases healed in from 5 to 8.5 weeks from the first symptoms and from 2 to 4.5 weeks from drainage. It was believed that the time of aspiration was unnecessarily prolonged in most cases. This is the method of choice for all effusions treated in the toxemic phase because the lung expands readily and obliterates the cavity, and the fluid does not loculate.

In the treated series it was found that the intrapleural administration of penicillin not only influenced the local condition, but also provided a systemic concentration for periods of from 24 to 48 hours. The dose should be from 120,000 to 240,000 units for an adult and 1,000 units per pound of body weight per 24 hours for children under 5 years. Sterile cultures from pneumococcal and streptococcal effusions are by no means a reliable guide to the elimination of infection and time to stop treatment. Smears negative for gram-positive cocci are much more reliable. X-ray evidence save for fluid levels was not a safe criterion on which to rely for the discontinuance of drainage. Following surgical drainage, the risk of secondary infection was great and this prolonged suppuration and healing.

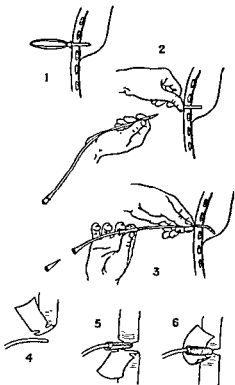


Fig. 1. Method of setting up intercostal drainage; (1) trocar and cannula inserted into the pleural cavity through a small incision through the skin and subcutaneous tissues; (2) mouth of cannula blocked with thumb till well fitting drainage tube is inserted while spigoted; (3) removal of cannula while air is prevented from entering pleural cavity by firmly gripping tube close to chest wall; (4) "elastoplast" cut to fit round and attach tube to chest wall; (5) second strip cut similarly; (6) third strip to hold the other 2 firm on tube. Tubes attached in this way have remained *in situ* 10 days in patients who were not restless.

Thin effusions in the toxic phase should be treated by aspiration of as much fluid as possible, the last 10 c.c. being saved for bacteriologic examination. Penicillin, 240,000 units (2,000 units per pound of body weight in children under 5 years) in 20 c.c. of saline solution, should be injected slowly into the cavity and the patient must be watched for coughing up yellow stained sputum as this usually indicates a bronchopleural fistula. If the cultures are positive, the treatment is repeated every 2 days until the effusion is frankly purulent. Then an intercostal drain is inserted at the suitable spot—a trocar and cannula with a drainage tube which exactly fits the bore of the cannula (Fig. 1.) are used. The cavity is left to drain overnight under a water seal if the toxic stage is passed. If not, an instillation of penicillin is given as soon as all the pus seems to be removed. Instillations are given twice a day in the tube with care to prevent the ingress of air. Up to 20 c.c. containing 500 units of penicillin per cubic centimeter are instilled, for pneumococcal or streptococcal infections if the toxic phase is passed; 600,000 units are injected twice

daily for staphylococcal infections. Drainage is set up twice a day, an hour before each instillation, by connection with the under water system.

A roentgenogram is taken the day following the insertion of the drain to check on its position and to determine residual effusion. The film is taken after drainage and before instillation of the penicillin. Drainage and instillation are discontinued when the pus disappears and the discharge is serous or slightly turbid and watery. If 3 serial bacteriologic examinations made on separate days are negative for smear and cultures, the drainage tube is removed and a final instillation is made as it is withdrawn. A dry dressing is fixed in place over the sinus and is not disturbed for from 5 to 7 days, by which time the wound should be dry. If it remains wet it should be examined bacteriologically for secondary invaders of the sinus tract. Breathing exercises are instituted the day after drainage is started to aid in drainage and expansion of the lung. Washouts should be avoided unless the tube is clogged by fibrin. If necessary, washing should be done under aseptic precautions in the operating room.

If these procedures are followed, the period of aspiration and injection lasts about a week, drainage from 10 to 14 days, and full healing of the sinus another 7 to 10 days, a total treatment of from 4 to 6 weeks.

Purulent effusions are best drained immediately, before the fluid becomes too thick to pass readily down the intercostal tube.

Small cavities bounded by the interlobar space walls may be treated by aspiration and injection alone. Aspirations are carried out every other day and 240,000 units are injected. Indications for discontinuing treatment have been described.

The consensus of opinion is that aspiration and injection with penicillin, with or without intermuscular injections, may clear up empyema, but the pleural thickening and resultant diminished respiratory reserve following long persistence in this treatment cannot be overcome except by standard methods of surgical treatment. The authors demonstrate a technique which combines the use of an antibacterial agent and drainage, and causes minimal discomfort to the patient.

Although the standard for successful results was high, 18 of the 20 cases treated as recommended came up to it. The earlier the effusion was detected and penicillin started, the shorter the duration of the illness. There is good reason to believe that the duration of treatment will be even shorter when these cases are treated at the earliest possible moment that fluid is detected and referred early to the surgeon. Chronic empyema present a year or more will probably not respond to the treatment outlined here.

Aspiration was preferred to drainage because continuous retention of the drug was assured and contact of the drug with the whole infected area was secured. The patients, however, preferred the drainage, and the change-over was made as early as possible and in accord with good treatment.

Nine of the 24 patients had bronchopleural fistulas and in spite of this the treatment was effective. Injections given more frequently than once every 48 hours might be recommended, as the patients cough up a fair proportion of the drug.

When infections were not located, penicillin injected into the pleural space had a well marked effect on the toxic signs but failed to prevent the formation of pus.

The continual danger of superadded infection by gram-positive organisms, once the drainage had been set up, compelled the authors to continue with penicillin until no further interference with the wound was necessary. Rib resection offers a freer portal of entry to invading bacteria and prolongs healing. Superadded infection with gram-negative organisms is more of a nuisance than of serious consequence. It can be avoided by careful dressing.

The x-ray findings were a source of considerable concern to the clinician. In some cases drainage was prolonged, fruitless explorations performed after drainage had been discontinued, and rib resection and thoracoplasty were considered on the strength of residual shadows. Screening is an essential factor in the treatment of empyema to distinguish fluid from pleural shadows and to aid in placing the tube correctly.

ROBERT R. BIGELOW, M.D.

### HEART AND PERICARDIUM

Levin, M. M.: The Clinical Picture and Therapy of Heart Injuries. *Vrachebnoe Delo*, 1945, p. 141.

In the majority of cases there is no clear cut picture of an injury of the heart. Especially during the first few hours of the trauma, signs considered typical for this type of injury, such as acute anemia and tamponade of the heart, are usually absent. In doubtful cases watchful waiting is indicated. The best approach is through the original wound which can be dilated by enlarging the port of entry and resecting portions of one or several ribs if necessary. Whenever possible the heart should be sutured *in situ*. The pericardium and pleura should be closed without drainage.

Early evacuation of the blood from the pleural cavity is important in the prophylactic treatment of infection as such blood may lead to a purulent pleurisy.

The remote results of suture of the heart may be quite satisfactory.

Subjective symptoms of an injury of the heart, such as anxiety, pain in the cardiac region, a sensation of oppression, weakness, dizziness, dyspnea, and fainting are present in not more than 50 per cent of the cases, and are of clinical importance only if combined with signs of progressing internal hemorrhage, acute anemia, compression of the heart, and a suggestive location of the external wound. Severe external hemorrhage is relatively rare because usually the blood first fills the pleural cavity.

The author prefers the approach through the original wound to methods employing musculo-

cutaneous or musculo-osseous flaps. In 1 case he was obliged to ligate the peripheral branch of the descending portion of the coronary artery. The operation was not followed by any immediate or remote untoward results. JOSEPH K. NARAT, M.D.

Finch, E.: Discussion on Surgery of the Patent Ductus Arteriosus. *Proc. R. Soc. M., Lond.*, 1946, 39: 107.

The chief danger in ligation of the patent ductus arteriosus is infection causing a subacute endocarditis which is fatal; but it is to be remembered that the patients with this condition, apart from being in danger from infection, must live the restricted life associated with a cardiac lesion. The diagnosis of the condition is not always an easy one. There are, however, some cardinal points in the uncomplicated case which may be mentioned. The patients usually are known to have had a cardiac lesion from childhood. They are usually small in size and they may complain of shortness of breath, but usually as they have had the lesion all their life, they are not conscious of this disability. On examination they have no finger clubbing and usually no cyanosis. Palpation over the pericardium may or may not reveal a turbulent heart action and a thrill over the upper part of the left chest, its maximum about the second interspace. Auscultation reveals the characteristic murmur suggesting a heavy machine shop and which is known as the "machinery murmur"; its essential feature is its continuous quality.

An x-ray film of the chest usually reveals certain characteristic features. The pulmonary artery is enlarged so that a bulge can be seen below the aortic knuckle, and there is usually some enlargement of the heart. The vascular shadows in the lungs are very obvious and in some cases markedly so.

Hunter believes that the mechanical defect, together with the risk to life, is sufficient to warrant surgical intervention in the uncomplicated case, except in that of the very young; in these cases operation should be postponed to a later date. A search for septic foci is made. Usually because of the cardiac condition patients have not had their tonsils and adenoids removed, but, when necessary, this is now a routine, the operation being performed under prophylactic doses of the sulfonamides. Breathing exercises are instituted as soon as the patients come into the hospital and are continued throughout their stay.

The operative technique employed by Hunter is the same in all cases and the approach used was that originally described by Gross. Although this approach is a limited one, it allows the reconstruction of the chest wall more completely and permits the re-expansion of the lung more easily than the thoracotomy incision. It does not allow, however, the same access in dealing with complications of the operation.

The ductus itself when defined is very short and runs an unexpected anteroposterior course. It can be elongated by gentle traction with a fine wire.

pulmonary artery while the ligatures are being passed. Two No. 8 silk ligatures are used as ties, care being taken not to damage the recurrent nerve with the ligatures.

The wall of the ductus itself varies in thickness. In the majority of cases it is very thin, and in 2 instances the author observed the blood moving in the vessel. In both of these the impression was given that the flow was from the pulmonary artery to the aorta. This is against all the views previously expressed, but these views have been largely theoretical. It has always been assumed that the flow was from the aorta to the pulmonary artery on the grounds that the pressure in the aorta was more than in the pulmonary artery and also that the enlargement of the heart suggested an extra load on the pulmonary side. This is further strengthened by the increased pulmonary vessel shadows as seen on x-ray examinations. It has been estimated that the flow through the ductus is very large, up to 50 per cent or more of the left ventricular output. It is remarkable that this extra work does not result in more serious signs of myocardial insufficiency, and when the increase in blood pressure and the great increase in the size of the heart that occurs when an arteriovenous fistula of similar size is caused by injury is considered, one must ask if there is not some factor present in the congenital case that has not yet been explained.

Surgeons are not satisfied with ligation in continuity, and there is no doubt that the next forward step in this region is to divide the ductus completely.

The difficulties encountered during the operation are: the problems in connection with exposure, local bleeding of a slight character but sufficient to obscure the field and make the procedure tedious, puncture of the pericardial extension along the ductus with a small constant stream of pericardial fluid, the presence of glands in the arch of the aorta which are sometimes difficult to clear from the ductus, and, the most serious, the tearing of the ductus either while it is being defined or due to the ligature material cutting through it.

The complications after operation are fluid or air, or both, in the pleural cavity. In no case has there been cause for anxiety during convalescence, and by expanding the lung with positive pressure to reduce the air in the cavity there should be no danger. In an uncomplicated case there should be no blood in the pleural cavity.

The usual convalescence is quiet in children: they are well after 24 hours, and it is probably only conservatism that confines them to bed for a week or 10 days. The follow up shows that both the adults and children are more robust and in better general health than before. It would be fair to say that they were unaware until after the ligation of the ductus what limitations had been imposed on them because of their disability. In time the ultimate fate of these patients will be known. At this time it can only be said that by ligation of the ductus we have reduced their chances of getting a bacterial endocarditis.

In discussing this article *TUNAS* thought that Hunter's novel suggestion that the blood flow in a patent ductus during postnatal life was from the pulmonary artery into the aorta could not be maintained, although it provided a ready explanation for the surprising cure when infection was present. There appeared to be ample evidence in support of the classic view that the blood flow was from the aorta into the pulmonary artery: (1) in uncomplicated cases there was no cyanosis which could be present if venous blood were sucked into the aorta from the pulmonary artery; (2) the low diastolic pressure usually associated with patency of the ductus was readily explained by the classic view but very difficult to understand if the blood flow were in the reverse direction (the diastolic pressure was regarded as inversely proportionate to the calibre of the ductus); (3) pulmonary congestion due to the overloading of the pulmonary circulation from the aorta was often found several years before other signs of heart failure developed; (4) dilatation of the pulmonary artery sometimes with actual aneurysm formation (an x-ray film depicting such an aneurysm was shown) was commonly present because of the raised pressure caused by the flow from the aorta; (5) the oxygen content of blood removed from the pulmonary artery at operation had been shown to be abnormally high; (6) pulmonary infarction always preceded systemic embolism when subacute endarteritis had complicated the picture; and (7) there was the irrefutable evidence of cardioangiography, revealing that none of the relatively concentrated dye in the pulmonary artery entered the aorta.

The indications for surgical closure of the ductus required careful consideration. Infection was undoubtedly an absolute and urgent indication for operation as the prognosis in unoperated cases had been almost universally fatal in the past. Symptoms or signs of cardiac failure were regarded as indications for operation. In addition, enlargement of the heart or a diastolic pressure below 60 was thought to foreshadow failure at a later date and was therefore grounds for surgical treatment. Retarded development in childhood was likewise an indication.

Preparation for operation in the uncomplicated case was not thought necessary. If infection was present a sulfonamide was given for 5 days before operation in order to reduce the fever. If it failed to do so, penicillin was given for a similar period and with the same object. An intravenous drip was started before operation in case of severe accidental hemorrhage, but was discontinued as soon as the operation was completed as the burden on the heart would be augmented by the infusion of fluids in the absence of blood loss.

In isolation of the ductus, it is important to recognize a fingerlike process of serous pericardium which often overlaps the anterior part of the pulmonary end of the ductus. This process should not be opened but should be stripped off the ductus toward the heart by blunt dissection. If it is opened, the constant leak of pericardial fluid will obscure the field.

Patience and gentleness are the passwords to success in the rest of the process of isolation.

The means whereby permanent closure of the ductus might be invariably obtained is the most outstanding problem. In view of the reports of successful cases which were treated by division between clamps, this should be considered in many, if not all, cases.

STEPHEN A. ZIEMAN, M.D.

Sellers, T. H.: Constrictive Pericarditis. *Brit. J. Surg.*, 1946, 33: 215.

Surgical intervention in disorders of the human heart is still regarded as something in the nature of a dramatic adventure, although in recent years it has been shown that the surgeon's hand is more kindly tolerated than was once thought possible.

Constrictive pericarditis which ties down the heart movement and produces chronic compression can be relieved only by some direct form of excision of the cicatrized pericardium.

The essence of constrictive pericarditis lies in the fact that contraction of pathologically formed intrapericardial adhesions restricts the normal action of the heart. It is well known that adhesions can exist without obvious interference with function: on the other hand, extrapericardial adhesions dragging on a diseased heart may add to its enlargement.

Starting then with a constricting and limiting layer of dense fibrosis in the pericardial tissues it is possible to see how increasing contraction brings about progressive impairment of cardiac function. The heart is practically strangled to death by cicatrization of its own movement.

The chief effect of the fibrosis is to limit diastole. The oncoming venous blood cannot be accepted in full amount by the restricted relaxation, and the pump, being insufficiently supplied, has less to deliver in its forcing stroke.

On the arterial side of the circulation, the limitation of the diastolic supply and consequent reduction of the systolic output is recognized by a low level systolic blood pressure (from 90 to 110 mm. Hg) and a low pulse pressure (from 15 to 25 mm. Hg not being unusual). In normal circumstances the response to exercise results in an increased output of the heart beat associated with some increase in rate, factors which combine to give a substantial increase in the volume output per minute. In constrictive pericarditis the output per beat is limited and the only way in which the necessary volume per minute can be sustained is by an undue increase in the pulse rate. Tachycardia is therefore a comparatively early sign and this becomes even more prominent on exertion. Dyspnea similarly occurs on exercise, but is absent at rest, and does not occur when the patient is lying flat (an important sign in the differential diagnosis). The presence of a paradoxical pulse is common.

Edema occurs in the dependent parts of the body, particularly in the legs, where in course of time the edema takes on a lymphatic appearance. Facial and arm edema may be present although they are not

always noticeable, but swelling of the face has been seen to develop in the course of days when rapid constriction was occurring. Cyanosis of varying degree is common and the extremities are blue, cold, and uncomfortable. These symptoms are out of proportion to the degree of dyspnea, being more dependent on the raised venous pressure than on the unduly reduced cardiac output.

Liver enlargement with ascites is one of the cardinal signs of constrictive pericarditis; both are proportionally much greater than in a comparable case of congestive heart failure. Apart from other significant signs the enlarged belly is almost bound to attract attention.

A remarkable feature in all this interference with the circulatory system is that the lungs are unaffected.

Such symptoms as lassitude, wasting, and weakness are regularly encountered and can be understood in the light of the general interference with the circulation.

To complete the classic triad of the compression syndrome, according to Beck, a small quiet heart should be added. This, however, requires qualification, since a reduction in the apparent size is by no means always seen, but the presence of a 'quiet' or practically immobile heart can be emphasized.

One of the fundamental points of constrictive pericarditis is that the heart muscle is normal in nearly every case. The myocardium is not diseased and it is potentially sound, although its activity has been sorely restricted in the process of constriction. If the restraining pericardium is removed, in the course of time the myocardium will be able to function with a power that approaches normal. Moreover, the condition only embarrasses the patient's existence when the local mechanical state has jeopardized the circulation as a whole.

Whereas the heart muscle itself is relatively normal, the same cannot be said about cardiac rhythm. The presence of contracting scar tissue and even plaques of calcium around the "pacemaking" area may account for irregular stimulation. All types of irregularity are encountered and periodic changes of rhythm are not uncommon. Operative handling of the heart produces extrasystoles and sometimes fibrillation, although these disturbances, even if they are more than transitory, generally subside within 24 hours. Any pre-existing irregularity is not necessarily replaced by normal rhythm after surgical removal of the pericardium, although this has occurred on occasions.

Electrocardiography shows remarkably uniform results, the principal features being a low voltage type of curve and lowering or inversion of the T-wave. The loss or inversion of the T-wave is commonly seen in Leads I and II and contrasts with pericardial effusions, which exaggerate the RS-T and the T-wave. After pericardiectomy there is some improvement in the voltage and a tendency for the T-wave to become less flat or inverted, but this is not marked for some time after effective liberation of the heart.

The current literature submits three possible causes for the origin of constriction—tuberculous infection, old pyogenic pericarditis, and idiopathic factors. The last accounts for the largest group in the published records, but it is easy to understand that the limited tissue available for microscopic examination from pericardial excision, and the duration of the disease fail to afford complete facilities for investigation.

The future of a patient with constrictive pericarditis depends on the rate of development of the condition. The slowly developing case which is not submitted to careful and systematic investigation may pass through many hands before the disease is finally diagnosed. These patients can live for years in limited and tolerable health.

Removal of the restraining pericardium to allow as full a ventricular expansion as possible is the only treatment for established pericardial constriction. Excision of all the pathological pericardial tissues would be the ideal; however, this is not practicable but the improvement following limited removal is remarkable. Excision should aim primarily, and possibly only, at freeing the ventricles, although for anatomic reasons even this is rarely achieved. The usual procedure is to resect the anteriorly placed pericardium and to carry the dissection outward over the apex and around the left border of the heart. The very thinness of the auricles and great veins makes interference over them a hazardous undertaking. Attempts to perform an extensive ventricular clearance without an opening into the left pleural sac often results in a more limited operation than was originally planned. To free the left border of the heart to an adequate extent the dissection should be carried posteriorly beyond the line of the phrenic nerve; but to do this and at the same time preserve the integrity of the pleural cavity is practically impossible. Consequently a deliberate transpleural approach to the heart may be countenanced as readily as the more popular extrapleural exposure.

The incision through the pericardium should be carried through both layers down to the heart muscle and not only through the parietal layer. This must be emphasized because it is quite easy to find a plane of cleavage between the parietal and visceral pericardium even after years of apparent adherence. The dissection plane between the visceral pericardium and myocardium is not as easy to define.

The full aim of dissection is to free the anterior surface of the right ventricle and the front part of its diaphragmatic aspect, and to free the left border of the heart from over the apex well on to the diaphragm and complete the excision laterally behind the level of the left phrenic nerve. The obliquely placed auriculoventricular groove marks the upper limit, and although clearance beyond this area is frequently advocated, it can be seen from a section of this region that there is little margin for error.

The tolerance of the heart muscle to handling is considerable. The ventricles respond to manipulation by repeated extrasystoles and are liable to

fibrillate if touched too often and too much; consequently periods of rest should be a routine part of the operation. During these intervals small warm packs or muscle grafts can be applied to bleeding areas on the freed heart muscle. The possibility of cardiac arrest is present, but with the heart practically under manual control this need not be too alarming; 5 cc. of 1 per cent procaine injected intravenously is said to be of value in controlling an unduly turbulent heart.

STEPHEN A. ZIEMAN, M.D.

## ESOPHAGUS AND MEDIASTINUM

Patterson, C. O., and Rouse, M. O.: Esophageal Varices. *J. Am. M. Ass.*, 1926, 130: 334

Esophageal varices on direct inspection through the esophagoscope are so large in some instances that they softly occlude the esophagus.

Patients have complained that substernal and upper abdominal distress precedes hematemesis, and it is possible for the patient and the patient's family to predict the approaching catastrophe of hemorrhage. It appears, therefore, that persistent substernal distress occurring in a patient having known or suspected esophageal varices would indicate the need for x-ray study and probably esophagoscopy as well as the injection of any veins large enough to produce symptoms.

The authors have noted that patients in a critical state of shock immediately before the injection, appeared in no danger at all a few moments after the injection, and were sitting upright in bed sipping milk 10 hours later. It would thus appear safe to give the injection treatment after the patient is in the proper hospital environment with reasonable assurance as to the diagnosis and with adequate facilities, particularly typed whole blood, available. The contraindications to esophagoscopy should, of course, always be kept in mind.

In the instance of another patient, the preparation for necessary splenectomy was repeatedly disrupted by massive hematemesis. Only after the injection of the sclerosing solution into the esophageal varices did the hematemesis cease and the red blood cell count maintain a safe level for surgery.

Hemorrhage occurs not infrequently from esophageal varices. This fact, as Kegaries showed, is best explained by the anatomy of the gastric veins, which tend to be subserosal and are held more firmly by the less elastic structure of the stomach. On the other hand, in the esophagus the varicose veins tend to be submucosal and are held less firmly by the areolar tissues of the esophagus; therefore they have a tendency toward sacculation and protrusion into the lumen of the esophagus, where they are more vulnerable to ulceration and rupture.

The ultimate evaluation of the treatment of esophageal varices by the injection of sclerosing solutions will take some little time and careful observation.

Five per cent sodium morrhuate solution was used for the injections.

JOHN J. MASON, M.D.

Montaño, G.: *Clinical and Roentgenological Aspects of the Differential Diagnosis of Mediastinal Tumors* (Consideraciones clínicas y radiológicas en relación con el diagnóstico diferencial de los tumores del mediastino). *Gac. méd. México*, 1945, 75: 277.

Since mediastinal pathology and especially that of mediastinal tumor is a very difficult one from the diagnostic standpoint, a study of it based on 80 cases seen in the Cancer Section of the General Hospital of Mexico City is presented.

The anatomy of the mediastinum and of its contained structures is reviewed. The author divides the mediastinum into an anterior and a posterior portion by a vertical plane passing through the pulmonary hilum, and into an inferior, middle, and superior section.

Symptoms produced by mediastinal tumors are essentially due to pressure or encroachment on, or displacement of, the adjacent organs by the process. These lesions may reach huge proportions without symptoms or may, by their relation to juxtaposed organs, produce definite localizing signs. Three general classes of symptoms are to be recognized: (1) respiratory or digestive symptoms, (2) symptoms due to the involvement of the nervous system, and (3) symptoms due to the involvement of the vascular tree. The first group of symptoms is very much as expected. The second group is also of understandable manifestations, although localization by the segments of the peripheral nerves involved may be helpful, or the discovery of a Horner's syndrome or recurrent laryngeal nerve palsy is quite diagnostic. In the third group, it will be remembered that the establishment of collateral circulation may indicate, for example, whether the superior vena cava is involved above or at the confluence of the azygos vein. The collateral channels are thoracic if the involvement is above the juncture, and abdominal as well as thoracic if both vessels are involved.

Of the 80 cases studied, 60 were manifestations of lymphoblastoma. The symptoms in order of frequency were dyspnea, supraclavicular or cervical thickening or tumefaction, pain, cough, edema, cyanosis, a collateral venous circulation, and hemorrhage.

The malignant mediastinal tumors, in general, do not produce the extensive compression or displacement syndromes that benign neoplasms do because they tend to invade rather than compress or displace, and their course is rapid, not allowing time for the development of a compensatory mechanism.

The roentgenological approach to the study of the mediastinum is also difficult because of the superimposition of the shadows produced by the several organs contained within it. Demonstration of abnormality depends on the encroachment of the process onto the space occupied by the lung field.

The first question to settle is whether the abnormal x-ray shadow is primarily in the lung or in the mediastinum. This can be inferred by observing the

angle of incidence of the shadow with the mediastinal border (according to Lenk). Oblique projections of the thorax will be useful in determining whether the mediastinal lesion is anterior or posterior.

Malignancy is suggested by irregular borders of the shadow, which indicate invasiveness. The degree of displacement or compression of the adjacent organs is important, in that benign tumors are more apt to present this feature in greater degree than infiltrative malignant ones. A symmetrical tumor suggests a single origin in contradistinction to a lobulated one; the latter suggests a multicentric character such as occurs in tumors of the lymphatic group.

Finally, irradiation can serve as a basis for classification of these tumors by the type of response produced. Great radiosensitivity indicates tumors of the lymphoblastoma group. Within this group certain variations permit distinctions, for example, between Hodgkin's disease and the more radiosensitive types. Moderate response is seen in carcinomas of the thymus or thyroid, fibrosarcoma, and metastatic carcinoma. No response suggests a histologically benign neoplasm, or aortic aneurysm.

The location of the tumor offers some differential help: it is in the anterior mediastinum, one should suspect cysts, teratomas, intrathoracic goiters, tumors of the thymus, or aortic aneurysms; but if it is in the posterior mediastinum, one should expect tumors of neurogenic origin, vertebral tumors, cold abscesses, lymphatic tumors, or aneurysms of the descending aorta.

Numerous illustrative roentgenograms are appended, without case histories.

HIRAM T. LANGSTON, M.D.

Adams, W. E.: *Surgery of the Mediastinum*. *Surg. Clin. N. America*, 1946, 26: 130.

During the past three decades, with their advances in the control of surgical pneumothorax, exposure of the mediastinal structures has become possible and treatment of congenital lesions, infections, tumors, cysts, or traumatic lesions has advanced apace. The scope of surgery in this region is now extensive. The details of 3 cases illustrating the more common procedures are given.

The first case was that of a 45 year old, white woman with a dermoid cyst of the mediastinum. She came under observation because of an intrathoracic mass discovered by a routine employment roentgenography as the condition was virtually asymptomatic. Her general condition was excellent, positive findings being confined to the chest. The roentgenogram revealed a huge rounded mass some 14 cm. in diameter in the right lower anterior lung field. Normal diaphragmatic motion was present and no expansile pulsation could be made out fluoroscopically. No calcification could be seen in the mass.

Thoracotomy was performed through a right anterolateral incision. The pleura was entered through the sixth interspace and additional exposure



was secured by dividing the fourth, fifth, and sixth cartilages and extending the incision in this line. The mass was easily removed after incision of the mediastinal pleura. The lung expanded freely. The thorax was closed with drainage. The postoperative course was uneventful and the patient was discharged at 2½ weeks. She was asymptomatic 11 months after the operation. The specimen was a cystic mass containing yellow fluid, cheesy material, and hair. The wall, microscopically, revealed stratified squamous epithelium, hair follicles, and sebaceous glands.

Mediastinal dermoids are usually located anteriorly and produce symptoms largely because of their size. They may undergo malignant change and for this reason their removal is indicated.

The second case was that of an 18 year old white male with a neurogenic tumor of the mediastinum. He presented a mass in the upper right chest adjacent to the mediastinum. It measured from 2 to 2½ inches and was relatively asymptomatic. It was found on a routine chest roentgenogram. The mass did not pulsate on fluoroscopic examination. No other abnormality was discovered. Under general anesthesia the right pleural cavity was entered through the bed of the sixth rib. This tumor presumably arose from an intercostal nerve and was found lying along the vertebrae opposite the third, fourth, and fifth ribs. After removal, the raw area was covered by pleura and the chest closed in layers, catheter drainage being provided. The postoperative course was uneventful and the patient was asymptomatic when seen 6 months later. The mass weighed 58 gm. and was considered a neurofibroma after histological study.

The mediastinal tumors of nervous tissue origin are usually located posteriorly. They are frequently asymptomatic, but they undergo malignant change and may produce symptoms by pressure on the adjacent structures. They are to be differentiated from cysts, intrathoracic goiter, and aneurysm.

The third case was that of a 55 year old white male with carcinoma of the esophagus, who complained of difficulty in swallowing for 9 or 10 months. This was first noted with solid food, later with liquids also, and during the last 2 or 3 months a tendency to regurgitate food was noted. Pain in the epigastrium, particularly when he was trying to swallow solid food, had been noted for this period also. He had lost 35 pounds in weight and a great deal of strength. He was markedly dehydrated and emaciated. A pronounced esophageal obstruction at the junction of the middle and lower thirds of the esophagus was demonstrated by barium study.

After 10 days of preparation, operation was undertaken. The left pleural cavity was entered through the bed of the eighth rib and the incision extended upward after resection of short segments of the fifth, sixth, and seventh ribs posteriorly and ligation of the corresponding intercostal vessels. The lesion extended from just below the aortic arch downward for some 4 inches. The mediastinal pleura was incised and the esophagus mobilized. The right

pleural cavity was not opened. The diaphragm was then opened and the stomach mobilized. The left gastric artery was ligated, but the gastroepiploic artery along the greater curvature was preserved. The spleen was removed to facilitate the procedure. The esophagus was transected at its lower end and the cardia closed by a double row of sutures. The esophageal mobilization permitted delivery of the tumor above the aortic arch. The stomach was brought up into the chest and anchored to the parietal pleura. The esophagus was anastomosed to an opening in the fundus of the stomach by a double row of sutures. Careful protection against soiling was taken and rubber shod clamps were used during the procedure. The diaphragm was closed around the stomach. Sulfathiazole crystals were placed about the anastomosis. The chest was closed in layers with drainage.

The procedure was performed without shock and convalescence was uneventful. The patient was allowed to drink small amounts of water on the fifth day, and by the twelfth day had progressed to 6½ feedings a day and fluids as desired. He was discharged in 3 weeks and was still well after 8 months. The tumor was a squamous cell carcinoma confined to the esophagus. The diagnosis was made by barium study and esophagoscopy.

Great progress has been made in the surgical management of these lesions. Operation offers the only chance for survival in these patients and the risk is not formidable.

Sketches, roentgenograms, and photographs of the specimen accompany the discussion.

HIRAN T. LANGSTON, M.D.

## MISCELLANEOUS

Svet, N. M.: *The Pathogenesis, Clinical Picture, and Therapy of Chest Injuries*. *Vrachebne Delo*, 1945, p. 135.

The author reports on 2,500 cases of chest injuries, 45.2 per cent of these wounds had a port of entry and exit, while 45.8 per cent were blind. Among the early complications, shock was observed in 0.6 per cent, acute hemorrhage in 2.3 per cent, and aerobic infection in 0.5 per cent. Among late complications the following are mentioned: empyema in 16.8 per cent, pleurosepsis in 2 per cent, infiltration of the lungs in 10.7 per cent, pulmonary abscess in 5.6 per cent, gangrene of the lungs in 0.3 per cent, pneumonia in 6.3 per cent, exacerbation of tuberculosis in 0.5 per cent, and toxic psychosis in 0.5 per cent.

In 54.3 per cent of the patients with hemorrhage the latter disappeared nearly completely, leaving in a small number of cases adhesences which yielded to diathermy, iodoiontophoresis, and other methods of physiotherapy. In 18.8 per cent hemothorax and hemopneumothorax became transformed into pyothorax, which in 2 per cent had an acute course in the form of pleurosepsis. Sixty-five per cent of the infiltrations were absorbed while in 35 per cent of the

cases an abscess developed. Of the secondary lobar pneumonias, 60 per cent were located at the site of the injury and 40 per cent on the opposite side. Contrary to the common pulmonary abscess which produces a characteristic roentgenogram, the traumatic abscess of the lungs may not show air above the fluid level. The latter spreads in concentric direction while the common abscess of the lung spreads in an eccentric direction.

The empyema complicating a hemothorax is usually unilocular while that complicating a hemopneumothorax is multilocular.

The following therapeutic measures were used by the author: (1) active therapy of the hemorrhages; (2) Bulau's drainage, instituted early and continued for a short time; (3) stimulation of the absorption of infiltrations and abscesses; (4) general stimulation of the organism in the form of blood transfusions, intravenous administration of glucose, employment of cardiac stimulants, vitamin C, and good nourishment; and (5) early employment of physiotherapy in order to prevent pneumonia and diminish anoxemia.

Aspiration of the hemothorax was usually started on the day following the injury. A rib resection was performed only for empyema of long duration or any other virulent process. As a rule, the drain was introduced in the ninth intercostal space in the posterior axillary line. A drain was never introduced into the port of entry of the missile.

In cases with empyema the pleural cavity was irrigated with potassium permanganate, hydrogen peroxide, chloramine, streptocide, rivanol, or alcoholic solution. Patients with abscesses or infiltrations of the lungs were given, in addition to other therapeutic measures, intravenous injections of sodium benzoate, rivanol, saline solution, calcium chloride, sodium salicylates, or novarsenol. The best results were obtained from intravenous injections of from 10 to 15 c.c. of a 10 to 15 per cent sodium benzoate solution given daily over a period of 10 days.

Iodoform in the form of an emulsion proved efficient in the treatment of gangrene of the lung.

Repeated blood transfusions up to 10 were given to patients with complications.

Patients with an open pyothorax were treated with Bulau's drainage and occlusive dressings after a preliminary introduction of Vishnevski's ointment into the pleural cavity.

In open hemothorax the gravity of the condition soon after the injury is attributable not to mediastinal flutter but to pleuropulmonary shock. Therefore, the advisability of transforming an open pneumothorax into a closed one is sometimes open to discussion.

Graded breathing exercises were instituted in all patients with penetrating chest injuries; they were started on the day following the trauma, in order to prevent pneumonia and anoxemia. The exercises were not employed in the presence of repeated hemorrhages, shock, or anaerobic infection. In patients with multiple rib fractures paravertebral block

with novocain was employed to diminish pain which would interfere with the breathing exercises.

Thirty-five patients, or 14 per cent, died. The mortality in empyema was 2.4 per cent, in lung abscess 2.1 per cent, in traumatic pneumonia 2.5 per cent, in pleurosepsis 24 per cent, in acute hemorrhage 28.5 per cent, in gas infection 16.5 per cent, and in shock 6.6 per cent.

Forty-seven and two-tenths per cent of all the patients with chest injuries recovered within 30 days after the injury, 23.9 per cent within 50 days, and 29.9 per cent within 60 days.

Foreign bodies in blind injuries usually became encapsulated.

If a chest injury is combined with a transdiaphragmatic trauma of the abdomen, either a typical or a transdiaphragmatic laparotomy is indicated.

JOSEPH K. NARAT, M.D.

Samson, P. C., Burford, T. H., Brewer, L. A., III, and Burbank, B.: The Management of War Wounds of the Chest in a Base Center. *J. Thorac. Surg.*, 1946, 15: 1.

This article encompasses the experiences of the first fully established center for thoracic surgery in the north African theater of operations receiving its patients from the Sicilian Campaign. The principles of treatment delineated are the outgrowth of an overall experience with some 1,500 major thoracic injuries. The trends of therapy are illustrated by reports of representative problem cases amply supported by roentgenograms and sketches.

Blood was found in the pleura in virtually all intrathoracic injuries. Treatment was by means of thoracostesis without air replacement, beginning after 3 or 4 days (during which time cessation of the pulmonary bleeding or leakage of air was expected, by virtue of the partial compression), unless the symptoms demanded earlier aspiration. Air replacement was believed to defeat the purpose of obliterating the pleural space by pulmonary re-expansion. Fever was frequently present, but generally subsided in a few days in the absence of infection.

The intrapleural blood frequently clotted; it may do this within a few hours. If the hemothorax was not reducible by thoracostesis, catheter suction also failed to provide significant improvement.

Clotting of the hemothorax is frequently followed by organization, although the factors responsible for this are not clear. Within a week fibroblastic and angioblastic proliferation may be seen extending from the pleura into the overlying fibrin coat. In 4 weeks, adult fibrous tissue can be recognized in the older layers, and in 6 or 7 weeks, the organized layer may be 1 cm. thick. The parietal portion is invariably thicker than the visceral. This is erroneously called "thickened pleura." The lung is encased in this cicatricial envelope, being thereby compressed and immobilized. Infection does not alter the process of organization, that element being manifested by leucocytic infiltration in the unorganized zone of the fibrin clot primarily.

The first application of the principle of decortication in this theater was by one of the authors (T. H. B.), in May, 1943. This operation is indicated when at least 50 per cent compression of the lung is present, especially if the apex is collapsed; and in those in whom aspiration has been unsuccessful and in whom there has been no appreciable pulmonary expansion at the end of 4 to 6 weeks following injury.

The optimum time for such intervention is between 3 and 5 weeks following injury. "The important technical considerations are: (1) meticulous establishment of the proper cleavage plane between peel and visceral pleura; (2) careful blunt dissection of the peel either digitally or by gauze dissector; (3) complete freeing of the lung where it is directly adherent to the thoracic wall, to the mediastinum, or along the fissural margins, so that circumferential expansion can be obtained; (4) decortication and mobilization of the elevated fixed diaphragm, with particular attention to redeveloping the costophrenic sulcus; (5) deliberate intermittent expansion of the lung under increasing positive pressure, with careful stroking of atelectatic areas." After decortication, a grossly normal, thin, translucent expansile pleura is found. Bleeding is only moderate and easily controlled by pulmonary expansion. Decortication of the parietal "peel" is not considered necessary.

Proof of infection in these cases was based on finding organisms in the bloody fluid aspirated from patients showing clinical signs of toxicity. There was frequently a delay in obtaining bacteriologic confirmation. Anaerobic streptococci and staphylococci were frequent offenders.

Small empyemas have been treated by the usual methods of aspiration and drainage, but larger ones (with 25% or more pulmonary compression) have been managed by evacuation of all clot and decortication of the parietal peel. This has been done under the protection of systemic and local administration of the sulfonamides or penicillin. The mechanism of production of post-traumatic empyema varies, since contamination may enter through the chest wall, from the lung by way of a bronchopleural fistula, or by spillage from an abdominal source when the diaphragm is involved. The latter type may occur as a result of contamination in a pleural space relatively free from blood and do well under the usual methods of drainage. Nearly every post-traumatic empyema, however, develops in a hemothorax (hemothoracic empyema) and the infection is contained within the walls of the intrapleural hematoma instead of being confined by the pleurae themselves. In these cases total empyemas are more frequent, and pulmonary expansion is more often problematical, as compared to postpneumonic empyemas, and periosteal reaction and clubbing of the fingers are not seen. Adequate drainage is necessary and can be promptly carried out without awaiting "thick pus," since the fear of mediastinal mobility is not great in view of the pathogenesis of the condition. Water seals are not mandatory after drainage. If pulmonary expansion does not occur in from 4 to 6 weeks,

decortication has given gratifying results. Decortication without preliminary drainage in patients in good condition is feasible and recommended.

Multiple empyema, particularly in the presence of bronchopleural fistulas, in an otherwise expanded lung, is best managed by accurately placed multiple rib resections, as indicated.

Because of the cloth and debris in the wound, foreign bodies (metallic from 1.5 cm. up in size) should probably be removed, preferably between the fourth and tenth days after injury. This allows the lung to recover from its original trauma and be readily expansile, yet not lay down dense pleural adhesions or heavy fibrosis around the missile. Most of the pericardial and myocardial foreign bodies should probably be removed. However, removal of retained fragments that are asymptomatic is a problem *sub judice*.

Continued intrapleural bleeding generally comes from some vessel in the chest wall. Severe hemorrhage has rarely been seen from a lung wound.

The 15 detailed case abstracts illustrate the diagnostic approaches, principles of management, operative details, and immediate end results. Thirty-two illustrative roentgenograms and 4 sketches are included.

HIRAM T. LANGSTON, M.D.

Keynes, G.: The Surgery of the Thymus Gland. *Brit. J. Surg.*, 1946, 33: 201.

Up to a recent date there has been almost complete absence of surgical interest in the thymus gland. In support of this statement the author points out that there has never before been a contribution on this subject in the *British Journal of Surgery*.

Surgery of the thymus principally includes operations for the relief of thymic asthma, tumors, and myasthenia gravis. Thymic asthma is sometimes seen in young children in whom there is a recurrent difficulty in breathing associated with stridor and cyanosis. Death sometimes ensues. The asthma has been supposed to be due to the pressure in the thorax of an abnormally large thymus, and attempts have therefore been made to relieve the supposed obstruction to respiration by removing the thymus. It was claimed that in four-fifths of the operated children the attacks of suffocation ceased, and stridor was less.

Surgical therapy, however, was shortlived and medical opinion has fluctuated as to whether the thymus gland is really the cause of thymic asthma. It is no longer generally believed that the thymus is the cause of death in the so-called "status lymphaticus." But apart from this there was another good reason why surgery for this condition has faded out and has not been heard of for many years. An enlarged thymus gland consisting largely of lymphoid cells can be made to disappear rapidly under x-ray irradiation.

Thymic tumors are common. Lymphosarcoma, perithelioma, Hodgkin's disease, spindle-cell sarcoma, and epithelioma have been described, but

their removal has seldom been attempted, and most of those that have been removed were in patients who had myasthenia gravis associated with the growth.

It seems that of the five kinds of thymic tumor the epithelial tumor is the only one that is ever found coexisting with myasthenia gravis and, furthermore, when the epithelial tumor occurs, the association with myasthenia is almost invariable.

Blalock's recent success with the relief of myasthenia gravis by thymectomy directed attention to this field of surgery, and since 1942 Keynes has performed 51 such operations. The technique employed consists in a T-shaped incision over the sternum and the latter is divided with a Schumacker's sternum splitter as far as the fourth cartilage.

Exposure of the mediastinum permits dissection of both lobes of the gland and their removal. On removal of the retraction the two halves of the sternum spring back into their proper position and the soft tissues over them are securely sutured in two layers with strong catgut. The cancellous bone heals rapidly and care is taken not to limit the maximum

excursion of the chest in any way by tight bandaging.

The association of a thymic tumor with myasthenia gravis has an important bearing on the treatment of myasthenia by thymectomy, which is often unsuspected. It seems that at least 1 in 10 of the patients coming to operation is found to have a tumor, and the implications of this fact are of considerable importance. The tumors are thickly encapsulated, but, nevertheless, they show a tendency to burst through the capsule, and histologically they consist of a homogeneous mass of epithelial cells in a state of great activity. Their appearance suggests that the margin between innocence and malignancy is rather fine, and the removal of these tumors at as early a stage as possible is of the greatest importance to the patient's welfare.

All patients with tumors tend to respond more slowly and incompletely than most individuals respond to prostigmine.

Of the 51 patients whom Keynes operated on, 38 are still alive and have been benefited by the operation.

STEPHEN A. ZIEMAN, M.D.

# SURGERY OF THE ABDOMEN

## GASTROINTESTINAL TRACT

Hobbs, W. H., and Cohen, S. E.: Gastroduodenal Invagination Due to a Submucous Lipoma of the Stomach. *Am. J. Surg.*, 1946, 71: 505.

The authors present a complete classification of the forms of intussusception which occur in the alimentary tract. They then present a case report of a gastroenteric type of intussusception seen in 1937.

The patient, a 61 year old white female, was troubled with constipation for 12 years. Three years before admission she began to lose weight and tired easily. In November, 1935 she had a severe paroxysm of pain in the right upper quadrant of the abdomen radiating to the back and right shoulder. It was accompanied by nausea and vomiting. She was treated medically for gall bladder disease and recovered, but had many similar milder episodes. In December, 1937 she was unable to retain food in her stomach, had mild pain, and vomited for 3 days before admission. Bowel movements were normal. For a year previously, she had noted a nontender mass above the umbilicus.

Physical examination revealed dehydration, a soft abdomen, and a freely movable (3 by 5 cm.) mass in the epigastrium in the region of the transverse colon. The admission diagnosis was carcinoma of the trans-

verse colon with metastatic obstruction of the pylorus. Gastrointestinal x-rays revealed that the antrum of the stomach did not fill and there was marked retention (50% after 48 hours). Laboratory examinations showed a moderate anemia. On the fifth day in the hospital the patient developed severe generalized abdominal pain with rigidity and tenderness.

Laparotomy was performed on the ninth day. At least two-thirds of the stomach with the greater part of the omentum had become invaginated into the duodenum (Fig. 2). The latter was dilated up to 3 inches in width. A tumor mass measuring about 4 by 3 inches in diameter was palpable at the duodenojejunal junction. By slight traction on the cardia and a milking manipulation, retrograde disinvagination was effected. The circulation of all bowel was found to be unaffected. After reduction a large intragastric tumor was palpated. The anterior wall of the stomach was opened and a large pedunculated soft tumor was found attached to the posterior wall by a broad short pedicle.

A sleeve resection was carried out because the nature of the tumor was uncertain. A cholecystectomy was done as the gall bladder contained numerous calculi. The patient made an uneventful recovery, regained 20 pounds of weight, and has been

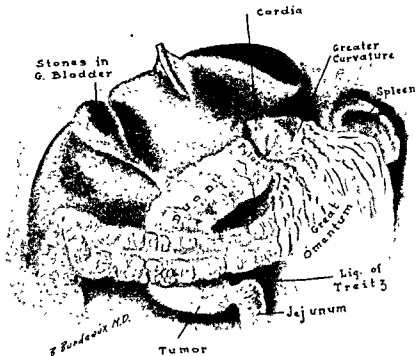


Fig. 1. The anatomic relationships encountered during the laparotomy.



invagination with an external mechanism to distinguish it from the usual intussusception displaying the internal mechanism. These classifications are suggested by the authors after a study and review of the 41 cases presented in the literature.

According to this nomenclature the authors' case presented was complete, central, of grade IV, and with an internal mechanism. Only 2 other cases reported were of this type; 9 were more severe; 7 were of grade II; and 4 were of grade III. The central type is more frequent than the lateral, and the complete more common than the partial.

The symptoms at the onset are those of a benign stomach tumor—pain in the epigastrium or umbilical region, nausea, vomiting, eructations, anorexia, fatigue, diarrhea, loss of weight, and emaciation. Hemorrhage and melena are frequent and at times a tumor is palpable. If the papilla of Vater is occluded, jaundice may occur. In a late stage the picture is one of intestinal obstruction requiring an emergency operation. Grades I and II may lead to a ball-valve syndrome with a sudden obstruction of the pyloric lumen by a relapsed tumor or intussusception. The symptoms are sudden with violent attacks of retching and vomiting accompanied by flatulence and pain. These attacks subside in time, and the patient is comparatively well between attacks.

Roentgenologically, in these cases Moore's criteria for the diagnosis of a benign gastric tumor are in part applicable. In addition, (1) a central area of translucency in the bulb with moderate transitory foreshortening of the antrum with a shift of the pylorus to the left may occur; (2) converging axial striations are caused by tension on the cardiac portion of the stomach; and (3) parallel transverse striations perpendicular to the axial striations are due to barium in the lumen of the intussusceptions. Other cases show the "abrupt sign"—abrupt delineation of the media running across the middle of the stomach, with or without spurs.

Natural cures of intestinal polyps following torsion and strangulation of the pedicle have been reported. Surgical excision of the offending tumor by local or sleeve resections is the usual procedure. The latter is preferred when intussusception is present. The prognosis is defined by the degree of prostration, the severity of the bowel damage, and the patient's ability to withstand the operation.

The lesions occur when there is a morbid feature, such as a tumor of the stomach or a mucosal tumefaction. Certain predisposing factors such as mobility of the pyloric or cardiac end of the stomach with relaxed gastrohepatic and gastrocolic ligaments usually are present. The tumor acts as a foreign body within the lumen and excites the gut to expel the tumor. Peristalsis carries it into the succeeding bowel segment, and the tumor pulls the stomach after it.

The mode of development of gastroduodenal invagination with an external mechanism is different. The stomach glides isoperistaltically and surrounds

the first portion of the duodenum. Fixation of the aboral bowel segment is an absolute requirement.

Two cases of double invagination involving the stomach are reported. ROBERT R. BIGELOW, M.D.

Delannoy, É., and Verhaeghe, M.: Ulcers Located High Up on the Posterior Surface of the Stomach (Ulcères haut situés de la face postérieure de l'estomac). *Rev. chir., Par.*, 1945, 64: 193

The diagnosis and treatment of ulcers located near the cardia are always difficult, but especially when such ulcers develop on the posterior surface of the stomach. This type of ulcer is rare as evidenced by the fact that the 4 cases here reported were the only ones encountered in a series of 1,500 gastrectomies. No instances of ulcer involving the tuberosity above the horizontal line passing through the cardia were encountered. This type is also extremely rare, occurring in less than 3 per cent of all gastric ulcers. The incidence of ulcer of the subcardia at the junction of the upper and middle third of the vertical portion of the stomach has been variously cited as from 6 to 17 per cent. Such ulcers are often of considerable size and have a tendency to come to a head at the upper margin or tail of the pancreas or to become adherent to the posterior abdominal wall. Spontaneous healing is probably not infrequent.

In gastrectomies for ulcer, heavy bands are frequently encountered, fixing the anterior surface of the pancreas to the posterior surface of the stomach. The pain is not of constant type, but in one case spontaneous subcostal pain or subcostal pain, induced by the method of Mallet-Guy for diagnosis of chronic pancreatitis, could be demonstrated. An earlier x-ray examination had yielded negative results, but a later film taken with this possibility in mind yielded positive results. The pain has also been known to simulate that of phrenic origin or of angina pectoris. The clinical symptoms are vague and of little diagnostic aid.

Roentgenographic examination by ordinary techniques usually yields negative results. The ulcer, even if it has had time to become visible, and is located in the middle of the posterior surface, will not change the appearance of the two curvatures. According to Moutier, these ulcers can be more easily demonstrated gastroscopically. Ledoux-Lebard and García Calderon have recommended a special technique for roentgen visualization of these ulcers. By following the descent of the first swallow of the contrast medium, a small hook of opaque medium may be demonstrated at the site of the ulcer, but this is a transitory phenomenon and might also be caused by a fold of the gastric mucosa. Ascending palpation following the ingestion of the contrast medium may likewise be employed to produce a suspended ulcer image. The best method consists of examination of the patient in dorsal decubitus after ingestion of sufficient contrast medium to fill the tuberosity. The posterior surface, having become inferior in this position, can then be examined as the

air forces back the anterior surface which has become uppermost. A combination of careful clinical, radiological and gastroscopic study will yield the best diagnostic information.

Various surgical methods have been recommended to deal with high posterior gastric ulcer. The technique of Pauchet, which has been found useful for high ulcer of the lesser curvature, will not suffice. In ulcers of the upper third of the posterior surface of the vertical portion of the stomach, a total subcardial gastrectomy may be necessary. In most ulcers of the sububerosity, subtotal gastrectomy is indicated, although in very small ulcers the section may be made obliquely from above downward, proceeding from the ulcer toward the greater curvature. This approximates Pauchet's "section en gouttière", and facilitates gastrojejunal anastomosis. Such interventions as transpyloric gastrectomy, wide gastroenterostomy, Madlener's operation, and total gastrectomy should be reserved for special indications. Transpyloric gastrectomy is recommended only for anemic, aged, or debilitated patients. Also Madlener's operation should be attempted only in aged or debilitated patients or in cases of constricted thorax with little prospect of tolerating a longer more difficult intervention. Good results were obtained by gastrectomy in all of the 4 cases treated by the authors.

EDITH SCHIANCHE MOORE.

**Krarup, N. B.: On the Results of the Medical Treatment of Peptic Ulcer.** *Acta med. scand.*, 1946, 123: 181.

In an effort to elucidate the results obtained by medical treatment of peptic ulcer, the author studied 665 patients (449 men and 216 women) admitted to Bispebjerg Hospital, Copenhagen, in the period from 1931 to 1938. All had uncomplicated cases of peptic ulcer, which were classified as bleeding (165 cases of hematemesis and 122 of melena) and nonbleeding or painful (81 gastric and 297 duodenal ulcers, all roentgenologically demonstrable) ulcers.

Patients with bleeding ulcers were given a puree diet throughout their hospital stay; those with gastric or duodenal ulcers were started on milk and strained oatmeal and allowed additions until they too were on a puree diet. Both types of patients were kept in bed for 3 weeks. After about 4 weeks they were discharged but advised to continue the dietary regime at home for at least four months. The follow-up study consisted of detailed questionnaires.

The immediate results of treatment were good. Ninety-five per cent of patients with bleeding ulcers were symptom-free at the time of discharge from the hospital. Five per cent of these had a relapse very soon after discharge. Of the patients with painful ulcers, 75 per cent of those with gastric ulcer and 80 per cent of those with duodenal ulcer felt well at the time of discharge. Of these patients, 20 per cent had a relapse almost immediately after leaving the hospital. Final results, after an observation period of at least 5 years, were less encouraging. Of the 626 patients who could be located, 29 per cent had

recovered, 36 per cent were improved, and 35 per cent had a poor result. The first two categories include patients who had suffered relapses; the last category includes those who died, i.e., 15 per cent of the total number of patients.

In analyzing the factors related to the disease, the author points out that age and sex seem to have little bearing on the outcome. The duration of the disease had a definite bearing on its outcome. Patients who had had ulcer for less than 6 months had a 50 per cent chance for recovery. This figure decreased to 20 per cent as the duration progressed to 3 years. A previous cure of the disease decreased the patient's chance for recovery. Results of treatment were poorest in patients with duodenal ulcers and best in those with bleeding ulcers. Fifty-eight patients were subjected to operation, 17 of them for perforation. The other 41, most of whom had duodenal ulcers, sought relief from symptoms. Relapses were frequent. The greatest number occurred in patients with gastric ulcers, 86 per cent of which recurred. Only 3 per cent of the group of patients died as a direct result of having an ulcer. Nine died of perforation, 8 of hemorrhage alone, and 2 of pyloric stenosis.

A comparison of the author's material with studies made by Nielsen and Mattisson showed that peptic ulcer has not undergone any essential changes as a disease, although it has undergone considerable change in its manifestations within the past 25 years. From being a disease chiefly involving the corpus ventriculi and encountered especially in women, it has now become a disease seen chiefly in man and most often involving the duodenum. Therapeutic results for the now predominant duodenal ulcer appear to be even poorer than would be expected from previous investigations.

The author's concluding opinion is that since medical treatment has effected such poor results for a steadily increasing number of duodenal ulcers and for recurring gastric ulcers, whereas resection appears to be producing an increasing number of cures, the indications for surgery should be broadened.

B. F. LOUNSBURY, M. D.

**Rickles, J. A.: Multiple Carcinomas of the Stomach.** *Surgery*, 1946, 19: 229.

The occurrence of multiple benign lesions of the stomach has been reported several times, and, although multiple malignancies of the gastrointestinal tract are second in frequency to skin lesions, multiple malignancies of the stomach are comparatively rare. A case in which 5 primary cancerous lesions of the stomach were present, and which was treated by transthoracic gastrectomy, is presented. The patient was a negro male, 54 years of age. Following preliminary study a diagnosis of carcinoma of the stomach was made. Abdominal exploration was performed and a large carcinoma of the cardia which had extended into the thoracic esophagus was found. The stomach was opened to permit examination and biopsy of a small, soft lesion at the pylorus and was



then closed, following which it was mobilized for a second stage transthoracic removal. Three weeks later a total transthoracic gastrectomy was performed with a good recovery.

Pathological study of the specimen showed ulcerating carcinoma of the cardiac end of the stomach infiltrating the muscularis, with metastases to the perigastric lymph nodes, and four papillary adenocarcinomas of the gastric mucosa apparently arising from adenomatous polypi. These tumors involved the mucosa and submucosa, but not the muscularis. Although much alike microscopically, these tumors were separated by normal mucosa and submucosa. The patient died suddenly several months later after a sudden onset of distention, which may have been due to metastases. JOHN L. LINDBLUM, M.D.

Norgaard, F.: Periodic, Spontaneously Remittent Volvulus and the Symptoms in Cases of Colon Elongatum. *Acta radiol.*, Stockh., 1945, 26, 163.

The term volvulus usually calls to mind an acute intestinal obstruction and consequent local circulatory disturbance due to a loop of bowel turning about its mesentery (pathological volvulus). The author reminds us, however, that lesser turnings of intestinal loops have long been known to occur without producing symptoms (physiological volvulus), and he records 4 cases which at roentgen examination of the colon with a barium enema were believed to have low grade asymptomatic volvulus of a redundant sigmoid loop and demonstrated an accompanying long axial torsion of the involved bowel. In such cases the volvulus and the consequent torsion at each end appeared not to exceed 180 degrees, so that no obstruction was offered to the passage of contrast material.

It is pointed out that while a volvulus of 180 degrees does not cause actual obstruction, it may result in a considerable obstipation and pain if the axial torsion be forcibly compressed into a shorter portion of the twisted loop or adjacent segment, as may occur secondary to increased dilatation of the loop. The author has encountered 4 cases in which the patients gave a long history of frequent attacks of sudden abdominal pain associated with obstipation. In 3 of these relief was customarily obtained by change of position (lying down) and followed by a sudden passage of much flatus, and in each a barium enema revealed this type of volvulus without ileus but with localized axial torsion in a redundant sigmoid (3 cases) or a long loop of the transverse colon (1 case). In each instance slight to marked resistance was offered to passage of the barium column at the point of the compressed torsion. Operation was performed in 2 cases, and in each the mesentery of the sigmoid loop was found to be scarred. Resection of the involved loop was done in 1 case, while in the other the loop was derotated and fixed. Following operation both patients had relief of the periodic attacks of pain. The author believes that these 4 cases represent instances of periodic, spontaneously remittent volvulus, which in the

fourth and most severe case had ultimately become unable to twist spontaneously because of the marked scarring of the mesentery.

In addition, the author presents 8 other patients complaining of attacks of obstipation, meteorism and vague abdominal distress, in whom low grade volvulus and axial torsions were found at roentgen examination. In most of these instances there was some obstruction to the passage of the barium column until the bowel became derotated.

LILLIAN DONALDSON, M.D.

Hunt, C. J.: Early Diagnosis and Management of Small Intestinal Obstruction. *Surgery*, 1945, 19: 237.

The purpose of this article is to emphasize the possibility of small intestinal obstruction when abdominal colic not localized to any quadrant or specific viscus in the abdomen occurs. Small bowel obstructions may be divided into the external, on the surface of the abdomen, and those hidden within the abdominal cavity. Those on the surface of the abdomen are strangulated obstructions and are easily diagnosed. The obstructions within the abdomen are hidden from sight and the diagnosis is often delayed, which results in serious complications. The intra-abdominal obstruction of the small bowel may be a simple form of obstruction in which the viability of the bowel is not in jeopardy, or it may be a strangulated or volvulus type in which the blood supply is obstructed and gangrene is imminent. In the former, delay is not so serious as in the latter. Thus, the surgeon is faced with two problems in obstruction of the small bowel: first, a clear distinction must be made as to the probable nature of the obstruction; second, the integrity of the blood supply to the bowel must be considered.

There are some points of diagnostic importance which will aid in arriving at an accurate conclusion. In simple obstruction, rigidity and localized tenderness are not present. When localized tenderness and rigidity are present in small bowel obstruction, it may be stated that a strangulated loop of bowel is present and the blood supply is in danger. The absence of early physical signs suggests the possibility of bowel obstruction. Passage of gas or movement of the bowels does not eliminate the possibility of obstruction. The typical transverse pattern visualized on x-ray examination is not necessary for a diagnosis of small bowel obstruction. Collection of gas in the small bowel of an adult may be considered as synonymous with obstruction, but in very small children gas may be seen in the small bowel and be of no diagnostic significance. Gas appears early after the onset of obstruction and is usually demonstrable within a few hours. The distribution of gas in the small intestine is indicative of the probable type of lesion. In simple obstruction it may be centrally located, with a transverse loop axis, while in loop obstruction the dilated loops may assume no definite pattern and proximal bowel distention is slow in developing. If the walls separating

the loops are thick, it signifies the presence of fluid or exudate. Gas may be demonstrated long before distention and the transverse x-ray pattern appears. In postoperative distention there may be a question as to whether a mechanical obstruction or paralytic ileus is present. In the former event, the small intestines are distended, while in the latter there is distention of both the small and large bowel.

The simple adhesive obstructions are the most common types involving the small intestine, and their presence can be detected early by roentgenographic study. Loop obstruction presents an entirely different roentgenographic pattern and a distinct surgical urgency because of impending bowel gangrene. Small bowel obstructions frequently occur in association with inflammatory lesions within the abdomen and usually present the characteristic pattern of a progressive proximal bowel distention in which the viability of the bowel is not in jeopardy. In this type of obstruction it is often not necessary to interfere surgically, as the condition results from localized inflammation and edema which will usually subside. Surgery is attended by great danger to the inflamed edematous bowel and may lead to extension of the infection. Intestinal decompression by intubation and appropriate systemic measures will usually result in recovery. Mesenteric thrombosis is characterized by acute sudden pain and gaseous distribution in the small intestine. Intrinsic lesions obstructing the small bowel are due to the occasional obstruction from a gall stone or incomplete obstruction from a neoplasm. In partial obstructions much difficulty may be experienced in making a diagnosis from the roentgenographic film unless intermittent complete obstruction is present. The use of an opaque medium is an aid to diagnosis in these cases. Any retardation of the barium in its progress through the intestinal tract or the detection of a malformed loop is of great significance. The diagnostic and therapeutic value of the x-ray in intussusception is discussed.

The use of the Miller-Abbott tube is contraindicated as a preoperative measure in loop obstruction, volvulus, or in strangulated obstruction when the viability of the bowel is in jeopardy. It may be employed to advantage in selected cases of intestinal obstruction. The technique of the passage of the tube is described.

An analysis of a series of 41 operative cases of obstruction of the small intestine in which there were only 3 deaths is presented.

JOHN L. LINDQUIST, M.D.

Barney, C. O., Roettig, L. C., and Jones, G. F.: Mechanical Intestinal Obstruction following War Wounds of the Abdomen. *Med. Clin. N. America*, 1946, 30: 337.

The authors state that never before have so many soldiers sustained abdominal wounds and survived to return to civilian life, and never before have so many young adults suffered injuries to, and under-

gone multiple celiotomies on, their peritoneal cavities. As a result, intestinal obstruction due to adhesions is being encountered with increasing frequency. Mechanical obstruction as a result of abdominal wounds of either the liver or the small bowel was encountered in 1 of every 18.5 cases on the Surgical Service at Rhoads General Hospital, Utica, New York, during the past year. The incidence of obstruction of the small bowel was 3.5 times greater than that of obstruction of the large bowel.

In obstruction of the small bowel, all manner of kinks, torsion, and internal herniations may be encountered. The most common forms are the "fixed kink," the "closed loop," or the "double fixed kink," and the "traction obstruction" with an adhesive band at the apex of a loop of gut acting as an axis about which a volvulus can take place.

In colonic obstruction, the most common finding is an inadequate lumen, often resulting from a Mikulicz type of colostomy closure.

The authors do not await such advanced signs as "the stepladder effect" on either inspection or x-ray examination, nor do they await fecal vomiting. The most common symptoms in obstruction of the small bowel are the onset of increasingly severe intermittent crampy abdominal pains accompanied by nausea, and usually by vomiting. Unless perforation has already resulted or is imminent, marked abdominal rigidity is usually not present. Auscultation of the abdomen is most important. At the onset of obstruction, violent intestinal peristalsis can be heard. Later the abdomen is more quiet and the cracked bell sound is heard. In the roentgen examination, the stepladder effect should not be used as a criterion. The visible distention of an isolated loop or loops of small bowel indicates an obstruction which usually requires surgical intervention.

In large bowel obstruction, the symptoms develop more slowly and are more mild in character. The patient complains of mild abdominal cramps, particularly after meals, abdominal fullness, and often nausea. A history of closure of a colostomy is important. No relief will be obtained with enemas, since the rectum is usually empty. A skiodan enema is of value in localizing the exact point of obstruction, after a flat plate has shown marked distention of the colon proximal to the point of obstruction.

The authors believe that prolonged observation has very little or no part in the treatment of complete mechanical intestinal obstruction following abdominal war wounds. They believe that an early celiotomy offers the most satisfactory means of removing the cause of obstruction and saving the patient's life. Although it is admitted that the Miller-Abbott tube is of definite value in the treatment of inhibition ileus and in incomplete small bowel mechanical obstruction, the authors are opposed to its use in complete obstruction following abdominal war wounds.

In the authors' experience with obstruction following abdominal war wounds, the incidence of strangulation or marked interference of blood supply is far

greater than the usual 10 per cent figure. This is one reason why they are not in favor of the routine use of a Miller-Abbott tube. As soon as the diagnosis is checked by means of positive physical findings and x-ray evidence of a distended loop, Wangensteen duodenal drainage is started. Estimation and correction of the fluid and electrolyte balance are carried out as rapidly as possible. A celiotomy is then performed without further delay. All possible raw surfaces are peritonealized after the strangulated areas are released. When too extensive damage to a loop is noted, resection and anastomosis are done. Postoperatively, Wangensteen suction is continued for at least 48 hours. Penicillin and sulfadiazine are given in adequate amounts. Prostigmine in 1:2000 strength is administered for at least 5 to 7 days postoperatively, starting with one ampule every 3 hours from the first day and gradually decreasing the dosage. Fluid and electrolyte balance are maintained and amino acids and vitamins are administered.

In the treatment of complete obstruction of the colon, it is usually possible to do a primary resection and an end-to-end anastomosis by an aseptic technique. Occasionally it is possible to straighten out an angulation or correct a narrowing of the lumen by longitudinal incision of the bowel and transverse closure. When colonic obstruction is not quite complete, it is often possible to delay operation sufficiently long to administer sullasuxidine and sullaganidine preoperatively. In the authors' series, none of the patients treated in this manner have had an unsuccessful result or postoperative peritoneal infection.

HAROLD LAUFMAN, M.D.

**Bottin, J.: Communication between the Duodenum and the Pancreas** (Communication entre le duodenum et la pancréas). *Rev. belge sc. med.*, 1942, 14: 13.

The question of a communication between the pancreatic ducts and the bile ducts has gained great importance in the pathogenesis of pancreatic necrosis. A number of experimental and clinical studies have demonstrated a reflux from the duodenum toward the bile and the pancreatic ducts. Pancreatic necrosis has been caused by the migration of parasites from the duodenum into the pancreatic duct, by obstruction of the pancreatic duct by a grain of oat and, in 1 case, by a melon pit. It has been suggested that most of the cases of acute pancreatic necrosis originate from a lesion of the pancreas which causes paralytic duodenal obstruction with paralysis of the sphincter of Oddi, and this in turn allows a reflux of duodenal secretion into the pancreatic duct.

The author reports a series of experimental studies on the dog:

**X-ray study.** A duodenal obstruction was produced in the dog and was followed by the injection of an opaque solution of sodium iodide into the duodenum. Roentgenograms taken the day after and repeated daily were unsuccessful in demonstrating a reflux toward the pancreatic duct.

**Bacteriologic study.** Aseptic removal and culture of small portions of the head of the pancreas of the dog almost always yield bacteria of the streptococcus or bacillus perfringens group. A similar excision from the dogs with duodenal obstruction yielded, in addition, the bacillus coli, enterococcus, bacillus tetragenus, bacillus putrificus, and at times, even the bacillus tetani. Since these bacteria are frequently found in the intestine of the dog, a reflux from the duodenum toward the pancreatic duct appears likely.

**Enzymatic study.** Trypsin occurs in the pancreas in an inactive form. A piece from the duodenal portion of the pancreas of a healthy dog exhibits a very low tryptic activity upon gelatin, graded by index 4. Pancreatic tissue from a dog with duodenal obstruction shows a highly increased tryptic activity, between 1,024 and 5,000. This is probably due to activation of the pancreatic enzymes by a reflux of duodenal kinase. It is unlikely that the kinase has reached the pancreas by the blood stream, because such increased tryptic activity is almost limited to the duodenal portion of the pancreas, and because the remarkable degree of activation observed does not compare with the activation obtainable by blood.

**Section of the pancreatic ducts.** If the main and accessory pancreatic ducts were cut from 3 to 4 mm from the duodenal wall and left open, the animal suffered no damage, and an exploratory laparotomy after from 24 to 96 hours showed only a thin peritoneal exudation, due to pancreatic juice which had escaped from the cut ends of the ducts. There was no trace of tissue necrosis. If, on the other hand, the duodenum was obstructed at the same time, the animals succumbed from 48 to 96 hours after the operation. The autopsy revealed necrotic foci in the pancreas, fatty necrosis of the mesentery, and, at times, a diffuse peritonitis. This indicates an activation of pancreatic enzymes by a reflux of kinase from the obstructed duodenum through the cut distal stumps of the pancreatic ducts.

The author concludes that in certain cases of high intestinal obstruction a reflux takes place from the duodenum toward the pancreas.

ARTHUR J. LESSER, M.D.

**Larsen, S. B.: Some Cases of Intestinal Tuberculosis in Phthisics, with Reference Especially to the Prognosis.** *Acta radiol.*, Stockholm, 1945, 26: 117

The author reports his x-ray findings in 32 cases of intestinal tuberculosis assumed to be secondary to known and proved pulmonary tuberculosis. Histological proof of intestinal tuberculosis was established in 3 cases. All cases were examined by means of the oral administration of barium. The diagnostic x-ray criteria were: hypermotility in 23 cases, filling defects in 32 defects, ileostasis in 15 cases and a positive Stierlin's sign—absence of barium in the affected section of the cecum and ascending colon, while barium is present above and below it—in 1 case. The lesions seemed to be confined to the cecum

and ascending colon in 28 cases, but appeared to extend into the ileum in 4 cases.

All of the cases were treated with total body carbon arc light baths and 1 case also with x-rays. Twenty-one cases were followed up by further x-ray examinations. These subsequent examinations were entirely negative in only 3 cases.

GERHART S. SCHWARZ, M.D.

Gray, H. K., and Sharpe, W. S.: Gastric Retention after Posterior Gastroenterostomy for Duodenal Ulcer; Prevention and Treatment. *Ann. Surg.*, 1946, 123: 397.

A comparative study was made of two groups of consecutive cases of 100 each in which posterior gastroenterostomy for duodenal ulcer was performed. The factors of age, sex, acidity of lesion, position of stoma, and technical skill were fairly constant. Because of the high incidence of post-operative retention in group 1, changes in the technique of operation and of postoperative care were made in caring for the patients in group 2 in order to combat postoperative gastrojejunitis, to promote peristalsis, and to avoid overloading the stomach. These changes consisted of the use of three rows of sutures instead of two, as well as the postoperative regulation of fluid intake and the administration of medications such as tablets of aluminum hydroxide gel (creamalin tablets), neostigmine (prostigmine methylsulfate), phenobarbital (luminal), atropine, diphenyl acetic acid, and diethylaminoethanol (transent).

A comparison of the two groups revealed that the average incidence of retention of any degree decreased from 35 per cent in group 1 to 19 per cent in group 2 and the average incidence of serious retention (persisting longer than 5 days) decreased from 24 to 13 per cent. In the first group 6 patients were subjected to a secondary operation; in the second group there was no necessity for reoperation.

There is no single cause of postoperative gastric retention, so there can be no single remedy. The temperament, racial characteristics, and emotional stability of the patient, as well as his economic and social stresses, are important. The size and position of the stoma, operative technique, and the pre-operative and postoperative care are similarly important.

Regurgitant vomiting is of two general types: (1) the vomiting that develops immediately after operation, which suggests mechanical obstruction, and (2) the vomiting that develops between the sixth and tenth days after operation, which occurs most probably because of stomal edema and inflammation. For the first type, some further operative procedure is frequently necessary; for the second type, supportive measures involving a knowledge of the principles of blood chemistry and fluid balance are usually sufficient.

Each surgeon should adopt an operative technique and a program of preoperative and postoperative care that embody the principles which in his

hands give good results. In the authors' experience, the stoma is best made on the posterior wall of the stomach with the proximal loop of the jejunum attached near the lesser curvature at the level of the angle of the stomach. The stoma is made to run diagonally downward and to the patient's left toward the greater curvature. Three rows of suture should be used in the anastomosis, the third row solely to allow careful approximation of the mucosal edges and to cover all denuded portions. The distal loop should be carefully replaced in the abdominal cavity to lie behind all other loops of bowel. If a secondary operation is considered, jejunostomy alone is the procedure of choice and is usually all that is necessary.

Crook, E. A.: Nonspecific Intestinal Granuloma. *Proc. R. Soc. M., Lond.*, 1946, 39: 123.

In reporting 5 cases of intestinal granuloma or regional ileitis, Crook emphasized the varied clinical picture which this condition may assume. Severe hemorrhage was the chief symptom in 2 instances and fistula in 2 others, while abdominal pain associated with a tumor mass was the predominant complaint of the fifth patient.

The cause of the disturbance was obscured in each case and operative treatment failed to arrest the pathological process. The histologic appearance of the tissues and the liability of the disturbance to recur after operation seemed to point to an infection as the causative agent, the true nature of which was undiscovered. The topic was enlarged upon by Manson-Bahr, who emphasized that the pathological process can be divided into various stages:

Stage of acute suppuration. The affected length of the bowel is dark red in color and greatly thickened and there are usually yellow shreds of fibrin adherent to the inner mucosa. The nearby glands are enlarged and red in color. There is free, sometimes turbid, fluid in the peritoneal cavity. Miliary abscesses sometimes found in the submucosa resemble those seen in full blown phlegmonous gastritis.

Chronic stage. Descriptions of this stage are commonly found in the literature. The appearance of the affected bowel to the naked eye is typical and corresponds to Dalziel's simile of an "eel in a state of rigor mortis," or it is more commonly referred to as the "hosepipe appearance." The serous surface of the bowel has a grayish pink color with white, thickened patches representing organized fibrin. The terminal portions of the affected loop are often affixed to the pelvic brim by recent adhesions.

The fibrostenotic stage. In this stage the cellular structure has largely been replaced by fibroblasts which have laid down collagen fibers, and these have produced marked narrowing of the area. It is this stenosis which gives rise to the roentgenographic "string sign of Kantor." As this constriction advances, the blood and lymphatic supplies of the bowel are interfered with and widespread ulceration of the mucosa takes place.

**Fistula formation.** As originally pointed out by Crohn, there is a marked tendency toward the formation of fistula and this may precede even the initial symptoms. These fistulas sometime travel a long distance before they reach the surface. It has been suggested that they may be of chemical origin, due to the action of the intestinal juices or possibly to the virus of lymphogranuloma inguinale.

In the discussion of the etiology it was stated that the chronic stages of Crohn's disease have certain resemblances to tuberculosis of the hyperplastic type, but no subserous tubercles have ever been demonstrated. The general form of the lesions in the large bowel, when these are encountered, bears a resemblance to the intestinal phenomena of lymphogranuloma. Moreover, phlegmonous enteritis has the same pathological picture as that of Crohn's disease and its resemblance to phlegmonous gastritis has already been observed. From a correlated study, positive cultures of bacillus dysenteriae, Flexner and Sonne, were obtained during the acute and positive agglutination tests in the chronic stages, which indicated a dysentery association. It has been suggested that chronic ileitis might be related to sarcoidosis. With this object in view, a skin lesion from a proved case of sarcoidosis was emulsified; this gave positive intradermal reactions in 2 cases of sarcoidosis and also in 2 cases of regional ileitis.

By the injection of various sclerosing agents into the mesenteries and subserosal lymphatic channels and the introduction of bacteria intravenously at the same time, edema and extensive infiltration of the bowel wall can be produced; this suggests a low grade lymphatic infection. However, this has been interpreted as showing that disease of the mesenteric glands might be primary and that the ileitis might be due to the lymphatic block. Moreover, a streptococcus of the enterogenous type may be isolated from the floor of the ulcers as well as from the peritoneal fluid. If the bacterial nature of the disease is accepted we must be prepared to explain the mode of entry. The ulceration might well prove the site of entry of the primary infection. Trauma such as fish bones may be the cause.

At present, histological study remains the only safe means of identifying the lesion, which appeared to be the result of hyperplasia of the lymphoreticular tissue leading to obstructive lymphedema. The lymphadenoid masses vary in size, the largest forming cellular aggregates from 3 to 4 mm. in diameter and being visible to the naked eye. The smallest are 0.4 mm. in diameter and microscopic in size. In three-quarters of the cases these cellular nodes are scattered evenly throughout the edematous mucosa, ranging from 8 to 18 to the square centimeter. They show considerable cellular activity, a characteristic cellular response in a variable number of germinal centers making up a nodule of lymphadenoid tissue. The affected germinal center is later replaced by proliferating endothelial cells with weakly staining nuclei. In the midst of the cells constituting endothelial aggregates it is usually possible to find a

Langhans' giant cell which, when mature, resembles the giant cell system of miliary tuberculosis, but when this system has reached its full development, all proliferation apparently ceases. Never has the slightest evidence of caseation been seen. Some of the cells contain crystalline masses of various shapes and sizes. Probably the most arresting histologic feature is the presence in the regional lymph nodes of a clear cut specific formation of giant cell systems identical with those of the thickened mucosa. The natural retrogression of this lesion can best be studied in this situation. When viewed as an isolated and static histologic picture, the giant cell systems, both in the glands and the bowel, are indistinguishable from those of tuberculosis, but the absence of caseation and of acid fast bacilli force one to doubt their tuberculous origin.

From the purely histologic aspect, the appearance, evolution, and retrogression of the giant cell system of Crohn's disease resembles more the tissue reaction of Boeck's sarcoidosis than tubercle infection.

STEPHEN A. ZIMAN, M.D.

Atwood, W. G.: Meckel's Diverticulum. *N. Eng. Land. J. M.*, 1946, 234: 320.

Meckel's diverticulum is found in from 2 to 3 per cent of all autopsies, and about 3 times as often in males as in females. It is usually found from 30 to 45 cm. proximal to the ileocecal valve, but it may occur at any point between the pylorus and the ileocecal valve, usually arising opposite the attachment of the mesentery. Intestinal obstruction caused by a diverticulum is very rare; it may be caused by an obliterated omphalomesenteric duct forming a fibrous band constricting the bowel, or the diverticulum itself may cause constriction if its tip is attached to some point in the peritoneal cavity, or if the diverticulum is very long. The diverticulum may also invaginate itself and start intussusception; this is frequently facilitated by a polyp present in the diverticulum, or else a free diverticulum may be inverted as a whole.

Thirty-seven cases of Meckel's diverticulum have been recorded at the Truesdale Hospital in 69,000 admissions; only 1 case of intussusception as a result of inversion of the diverticulum was observed:

A case of a 7 year old boy is reported; he had complained of severe abdominal pain, nausea, and vomiting 2 days prior to admission. On admission the patient was cyanotic, and his general condition was extremely poor with a temperature of 100.6°F., pulse 130, respirations 22, labored; the abdomen was markedly distended, tympanitic, and tender, and no peristalsis was heard. Urinalysis showed a trace of albumin, hyaline casts, and pus cells; the hemoglobin was 80 per cent, the red blood count was 4,440,000, and the white blood count was 14,650. 69 per cent neutrophils, 20 per cent lymphocytes, 2 per cent large mononuclear leucocytes, 8 per cent band forms, and 1 per cent metamyelocytes.

The patient was very restless on admission, and was given 1,000 c.c. of 5 per cent glucose in saline

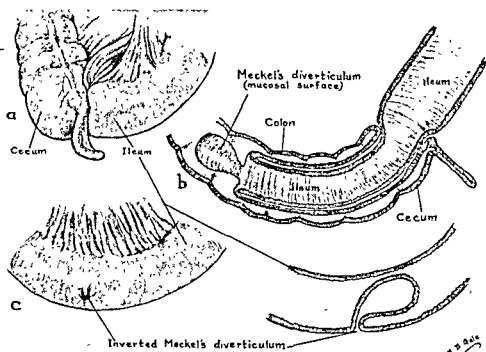


Fig. 1.

solution by rectal clysis prior to surgery. Under nitrous oxide, oxygen, and ether anesthesia, the abdomen was opened through a right rectus incision. A considerable amount of foul smelling fluid was encountered in the abdominal cavity and the small intestine was markedly distended. The terminal ileum was found to be prolapsed into the cecum through the ileocecal valve, as shown in Figure 1 a. Figure 1 b explains the mechanism of intussusception. The intussusception was reduced and an inverted Meckel's diverticulum was found at the apex (1 c). In spite of supportive measures, such as oxygen and intravenous fluids, the patient died an hour after operation. Permission for an autopsy could not be obtained.

The authors stress the need of early diagnosis and surgery in these cases, while the patient is still a good risk; they also recommend the search for a Meckel's diverticulum at every laparotomy.

ARTHUR J. LESSER, M.D.

Dixon, C. F., and Benson, R. E.: External Fecal Fistulas. *J. Am. M. Ass.*, 1946, 130: 755.

Early operation for the elimination of external fecal fistulas is usually not advisable.

Many fistulas close spontaneously with conservative, nonsurgical treatment.

In the early, acute stages of the formation of fecal fistula, treatment consists in transnasal intestinal suction, warm applications to the affected area, and adequate parenteral fluid, solution of glucose, saline solution, and vitamin replacement therapy. Parenterally administered sulfonamide compounds and blood transfusions may be of value.

In the subacute stage, efforts are directed toward eliminating the residual perifistulous inflammation,

decreasing the passage of intestinal contents through the fistula, and improving the patient's general condition.

Before instituting definitive surgical treatment for chronic persistent fecal fistulas, the following conditions should be met if possible. The etiological factors which are responsible for persistence of the fistula should be determined; the segment of intestine from which the false communications have their origin should be determined; it should be known whether the bowel distal to the lesion is patent; an adequate trial of conservative management should have been made; the general condition of the patient should be evaluated; all evidences of acute inflammation about the fistulous tract should have subsided.

Conservative surgical treatment, such as short-circuiting or sidetracking procedures, is used when the patient cannot meet the prerequisites for a more extensive, direct surgical approach.

In applying resection methods in the treatment of persistent, external fecal fistulas, the incision should, when possible, encircle and excise the fistulous tract; in most cases the results will be best if the peritoneum is opened and the affected segment of bowel is mobilized and inspected; all diseased tissue should be removed.

The types of persistent external fecal fistulas in which treatment is most difficult are (a) those in which the patient is a woman and the original pathological condition was pelvic inflammatory disease with pelvic peritonitis, (b) those in which the fistula arises in a region affected by severe diverticulitis with perforation, (c) those in which the fistula passes through bone, and (d) those in which the fistula is associated with enteroabdominal actinomycosis.

In the 65 cases of persistent external fecal fistulas of this series, in each of which treatment was surgical, there were 2 hospital deaths (3 per cent).

CHARLES BARON, M.D.

### LIVER, GALL BLADDER, PANCREAS, AND SPLEEN

McNamara, W. L., Baker, L. A., and Costich, K.:  
Aneurysm of the Hepatic Artery. *Ann. Surg.*,  
1946, 123: 427.

The authors report the case of a 44 year old man who was admitted to the hospital because of rheumatic heart disease, cardiac enlargement, and auricular fibrillation. While in the hospital he developed jaundice and a mass was palpable below the liver's edge. At operation the mass was found to be posterior to the gall bladder and ducts. Aspiration revealed blood and the diagnosis of aneurysm of the hepatic artery was made although the mass did not pulsate. No further surgery was attempted because of the patient's cardiac condition. The patient died 10 days after operation because of perforation of the aneurysm of the hepatic artery. There was no evidence of syphilis.

In reviewing the literature the authors found the suggestion that the artery be ligated because as the aneurysm develops, collateral circulation develops by way of the inferior phrenic artery. The mortality rate following ligation of the hepatic artery has been about 75 per cent in cases of aneurysm and about 60 per cent in conditions other than aneurysm.

EARL O. LATIMER, M.D.

Efskind, L.: Liver Changes in Surgical Conditions.  
*Acta chir. scand.*, 1946, 93: 81.

The author studied, by means of liver biopsies, the liver changes in surgical conditions. Biopsies were taken from the left lobe of the liver by means of a sharp instrument at the beginning and at the conclusion of operations. The specimens were examined for glycogen and fat content. The behavior of the mitochondria was scrutinized, while an attempt was made to study the circulatory condition from the appearance of the sinusoids. The author also observed the general cytological conditions in the liver cells themselves and the interlobular formations. The liver biopsies from a group of 120 patients were studied.

It was found that in patients with various serious disorders in the intestinal tract histological changes of a regressive nature were present in the liver cells. These changes were most pronounced in patients with protracted nutritional disturbances, hypoproteinemia and anemia, and in those with disorders of the liver and bile ducts. Topographically, these changes occurred at certain places of predilection in the lobuli of the liver and were considerably accentuated during severe operations. Also normal livers may show the same changes after severe operations, but in a minor degree. These changes occur in the following order:

- a. Abnormal mobilization of the liver glycogen
- b. Mitochondrial changes of a regressive nature
- c. Interstitial lymphocyte infiltration, sometimes with fibrosis
- d. Fat infiltration of the liver cells

The changes in the liver cells appear earliest and are most pronounced in the central parts of the lobuli. The fat infiltrated cells may often be well supplied with glycogen and frequently maintain their glycogen deposit for a long time, probably because of a kind of cellular blockade. The same may be seen in cases of chronic icterus and of considerable degenerative changes in the liver cells. Patients in whom the liver, in spite of adequate preliminary treatment, contains little glycogen and much fat show an abnormally great postoperative fall in serum proteins, with an inordinately long restitution time. The Kupffer cells show proliferative changes and in many cases a deposition of pigment or fat. The interstitial hepatitis seems to have arisen on a vascular, probably lymphogenic basis. Cholangitic infection has not been observed, even in cases of choledochal occlusion with infection.

EARL O. LATIMER, M.D.

Hudson, P. B., and Johnson, P. P.: Hemorrhage from the Gall Bladder. *N. England J. M.*, 1946, 234: 438.

The authors report 4 cases of hemorrhage into or from the gall bladder. Prior to this report 24 case reports appeared in the literature.

The first patient was 57 years old and had a severe anemia and melena of undetermined origin. X-ray examination of the gastrointestinal tract did not reveal any lesion, but the gall bladder was diagnosed as being diseased. The gall bladder was removed, and it was found to be distended and filled with stones and blood clots. The pathological diagnosis was malignant hemangioendothelial sarcoma.

In the 3 other cases blood was found in the gall bladders which also contained stones; in addition there was an acute or chronic cholecystitis.

EARL O. LATIMER, M.D.

Rienhoff, W. F., Jr., and Pickrell, K. L.: Pancreatitis: An Anatomic Study of the Pancreatic and Extrahepatic Biliary Systems. *Arch. Surg.*, 1945, 51: 205.

The authors examined the pancreas of 250 adults, both fresh and fixed specimens. The main and accessory pancreatic ducts were dissected out. In 73 instances (24%) they could find no junction of the pancreatic and bile ducts. In 92 specimens (37%) the common bile duct and the pancreatic duct were contiguous, and the dividing septum terminated from 1 to 2 mm. from the apex of their common orifice. In this group, however, a true ampulla was not considered present. In 81 instances (32%) a true ampulla was present, varying in length from 3 to 13 mm., while in 4 instances (2%) the main pancreatic duct was reduced to a fibrous cord. In 47 instances (18%), the length of the ampulla exceeded the

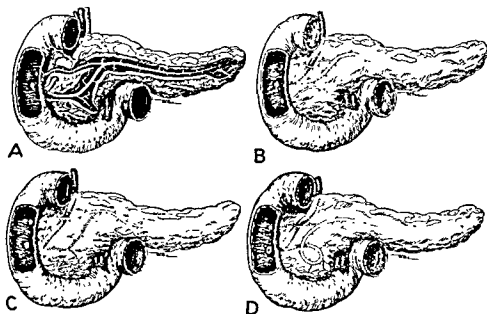


Fig. 1. A, The most constant arrangement of the pancreatic ducts. B, Specimen with three papillae. C, Dissected specimen of an adult pancreas showing an embryonic type of duct system in which the accessory duct carries most of the pancreatic secretion. D, Dissected specimen of an adult pancreas showing an unusual loop configuration of the main pancreatic duct.

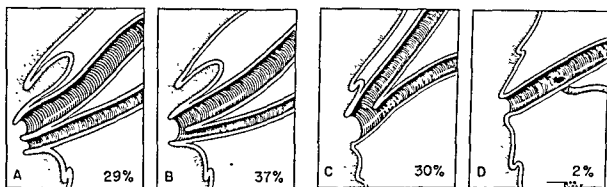


Fig. 2. Variations of the entrance of the main pancreatic duct into the common duct.

average diameter of the duodenal orifice and a complete block at the papilla would convert the two ducts into a communicating system.

The average diameter of the duodenal papilla was 3 mm., with limits of 1.5 and 4.5 mm.

Concerning the accessory pancreatic duct, in only 89 of 100 specimens studied for this purpose could any intraglandular communication between the ducts be demonstrated. In 4 instances the embryonic duct system was present, i.e., the accessory duct carried the greater part of the secretion, while the main duct was reduced to a fibrous cord; 85 specimens had a normal duct arrangement. In only 62 of these (73%) was the duct found to be patent; in other words, there were 23 instances in which the accessory duct did not communicate with the duodenum, regardless of the duct arrangement; this made a total of 34 per cent in which fluid could not pass from the main pancreatic duct to the duodenum

by way of the accessory duct. The average diameter of the undistended duct at the duodenal perforation was 1.6 mm.

EARL O. LATIMER, M.D.

**Reyes, H.: Acute Pancreatitis and Splanchnic Block (Pancreatitis aguda y bloqueo anestésico del espláncnico-semilunar).** *Arch. Soc. cir. hosp.*, 1945, 15: 723.

Three cases of pancreatitis in which lumbar sympathetic block was exhibited are reported. Two cases were operated upon, one presenting gallstones and inflammatory changes about the sphincter of Oddi and the other requiring drainage of an abscess which was secondary to a hemorrhagic type of acute pancreatitis. The third case was considered mild and treated conservatively. A diagnostic and therapeutic approach is given in view of these experiences.

When acute pancreatitis is suspected, the necessary laboratory studies, including those of the



amylase values of the blood and urine, are made. A lumbar sympathetic block is done, which presumably alleviates pain and shock. This permits an air contrast x-ray study of the stomach, to visualize the changes which have occurred in the region of the pancreatic shelf. These steps being promptly carried out, information concerning the type of pancreatic involvement is obtained and the type of therapy is indicated. The block is believed to favorably affect the local disease process, promote drainage of bile by its effect on the sphincter of Oddi, and lead to general improvement by interrupting impulses originating at the site of the disease.

Roentgenographic illustrations of the pneumogastrographic findings are appended to the relatively detailed case report. **HIRAM T. LANGSTON, M.D.**

**Curtis, G. M., and Movitz, D.: The Surgical Significance of the Accessory Spleen. *Ann. Surg.*, 1946, 123, 276**

The end-result of splenectomy for certain diseases involving the formed elements within the blood, and particularly for congenital hemolytic icterus or primary thrombocytopenic purpura, is influenced by whether accessory spleens which may be present are found and removed. That the unremoved accessory spleen may eventually cause a recurrence of either congenital hemolytic icterus or primary thrombocytopenic purpura subsequent to splenectomy is established by observation of three types: first, recurrence associated with an accessory spleen found, but not removed, at the time of splenectomy, since its significance was not then recognized; second, recurrences associated with accessory spleens overlooked at the time of splenectomy, but subsequently found at autopsy, after the patient had died of recurrence; and third, the most convincing of all, relief from a recurrence by the surgical removal of accessory spleens at a second operation.

The authors' report is based on 174 consecutive splenectomies, and on 4 explorations for splenic disease. One hundred and thirty-one accessory spleens were found in 56 of these patients, an incidence of 31.4 per cent. The two diseases for which the accessory spleen should be removed to prevent recurrence, namely, congenital hemolytic icterus and primary thrombocytopenic purpura, were also the two most frequent indications for splenectomy, which was performed in 53 and 33 instances, respectively.

In general, there is a greater incidence of accessory spleens among young persons. In the authors' cases there was an incidence of 50 per cent among patients in the first decade, and of 39.1 per cent among those in the second decade, which is greater than the increased incidence of accessory spleens ordinarily found in the young with "normal" spleens. In patients with hemolytic icterus, accessory spleens occurred in 57.1 per cent of those in the first decade, and in 42.8 per cent of those in the second decade of life. In patients with primary thrombocytopenic purpura, accessory spleens were found in 44 per cent

of those in the first decade and in 33.3 per cent of those in the second decade. The number of accessory spleens per patient varied from 1 to 10, 26 patients presenting but 1 accessory spleen. The size of the accessory spleens herein described ranged from 2 mm. in diameter to 3 by 2 by 2 cm.

A condition referred to as "splenosis," in which splenules in great numbers are scattered throughout the peritoneum appears to be a different clinical entity than true accessory spleens. Usually they originate by transplantation of fragments of splenic tissue, scattered about the peritoneum by hemorrhage from a ruptured spleen. This mechanism becomes of clinical significance during splenectomy for primary splenic disease, since the spleen may be accidentally torn either during manipulation or dislocation of capsular adhesions. Autotransplantation may thus occur from the fragments, and in a patient with congenital hemolytic icterus it is reasonable to assume that such might result in a recurrence. The authors believe that 1 case of this type has been reported in the literature although it was not originally so identified (McLaughlin, C. W., Jr. *Surgery*, 1942, 12: 419-425). Moreover, since splenic substance may even transplant to subcutaneous tissues, the incision should be protected during splenectomy in the event that the spleen is traumatized.

To avoid overlooking accessory spleens, a routine search should be made after the major spleen has been removed, and hemostasis effected in the following approximate order: (1) the hilar region; (2) the splenic pedicle; (3) the retroperitoneal region surrounding the tail of the pancreas; (4) the great omentum, and especially along its attachment to the greater curvature of the stomach; (5) the splenocolic ligamentary attachments; (6) the mesentery of both large and small intestines; and (7), in the female, the left adnexa. Because in 3 of 4 proved recurrences the overlooked accessory spleens were later found in the retroperitoneal region, about the tail of the pancreas, this area should be searched with special care.

In this series of cases the accessory spleens were distributed as follows: hilar, 54.2 per cent; pedicle, 25.1 per cent; omentum, 12.2 per cent; retroperitoneum, 6.1 per cent; splenocolic ligament, 1.5 per cent; and bowel mesentery, 0.75 per cent. In 85.7 per cent of the patients, the accessory spleens were found in but a single location, and in only 8 instances were accessory spleens found in two different locations. In all instances of double location, the hilus constituted one location. Consideration of the embryonic development of the spleen provides an understanding of the occurrence of accessory spleens as well as their various locations. Even left scrotal and mediastinal splenic masses may occur.

In 2 cases there was a recurrence of the disease following splenectomy, which was attributed to following accessory spleens. One patient had primary thrombocytopenic purpura that recurred 2 years after splenectomy; at autopsy, 2 accessory spleens were found in the retroperitoneal region near the tail of the pancreas. The other patient had congenital

hemolytic icterus that recurred about 4 years after splenectomy. At a second operation, 2 small accessory spleens were removed from the retroperitoneal tissue over the tail of the pancreas. Two years later the patient remained free from any evidence of recurrence of the disease.

Two cases from the literature are briefly summarized; in both cases accessory spleens were found and appeared to be the cause of recurrence.

Pedunculated accessory spleens may cause acute abdominal symptoms from infarction due to pedicle torsion, and this is shown in a summary of 2 such case reports obtained from the literature (Settle, E. *Am. J. Surg.*, 1940, 50: 22-26).

CHARLES A. WALTMAN, M. D.

### MISCELLANEOUS

Gordon-Taylor, G.: The Last 'Hate.' *Brit. J. Surg.*, 1946, 33: 230.

This article is an account of abdominal injuries sustained from the V1 and V2 bombs and the shelling of Dover. These injuries, fortunately, were not numerous—only 120 patients being submitted to operation. Of the 79 patients submitted to operation with intraperitoneal visceral injury due to the V1 flying bombs, 60 recovered (76%). Of the 13 explored in whom hemoperitoneum was found without visceral injury, 1 succumbed. The V2 rocket bomb caused 16 cases of intraperitoneal injury with 9 recoveries (56.2%). Of 6 patients with intraperitoneal injuries received during the shelling of Dover, 1 died postoperatively. Cases of "crush syndrome," retroperitoneal hematoma, and non-penetrating abdominal wounds are not included in these figures.

Injuries due to the flying bomb were less serious than those due to high explosive bombs. Property damage was greater than the damage to people, and casualties were usually secondary to the blast effects on buildings. Many writers have commented on the infrequency of intra-abdominal injury as a result of V1 explosions. Of the 79 patients in this series, 14 had no external wound and were suffering from intra-abdominal damage produced by blast or the collapse of buildings. A high percentage of wounds were due to splintered glass, and in this series most of the abdominal viscera were on occasion damaged by glass—the intestines, liver, spleen, the left gastric artery, and the pregnant uterus.

Of the 92 patients in this series who were submitted to laparotomy, 50 were females. The author presents 2 cases in which the fetuses were injured in utero and died later. Eight patients were under 10 years of age and 8 over 65. The eldest, 86 and with numerous intestinal wounds, died on the operating table. The flying bomb seemed to have a predilection for children, and the author presents the histories of 2 cases of blast injuries, 1 patient aged 7 and the other 15. At operation both had a hemoperitoneum without visceral damage, and both patients recovered.

The author refers to Kidd's case of successful suture of the inferior vena cava, previously reported in the *British Journal of Surgery* (1945).

A case is presented of a woman who claimed that a flying bomb fell on her. A wound of her right buttock communicated with her abdomen, and she was in shock. At operation, hemoperitoneum, bruising of the sigmoid colon and mesosigmoid, and a 3 inch tear in the serous and muscular layers of the sigmoid were found. The operation was quickly terminated because of the patient's poor condition. At reoperation the next day more blood had collected in the abdominal cavity but the bowel was all viable and no more lesions were found. The patient ultimately recovered.

Three cases are presented of patients who were hospitalized at the time they received their abdominal injury from the V1 bombs. Two of these recovered.

The author has 3 cases in his series of abdominal injury due to antiaircraft fire during the V1 phase. He gives the case history of a 68 year old warden with an abdominothoracic wound with recovery. A piece of metal entered the epigastrium and passed through the diaphragm and pericardium to lodge in the right ventricle. This was removed and the wound in the heart sutured. The patient recovered and was able to resume his ordinary duties troubled only slightly with dyspnea.

Of the 16 abdominal visceral injuries due to the V2 bomb which were submitted to operation, about one-half were due to crushing with associated fractures of the pelvis and other bones. Several dramatic cases are presented. A 52 year old woman had her abdomen impaled by a rafter beam which entered the right lumbar region below the 12th rib and projected out of the abdominal wall in the left iliac fossa. The greater omentum was traversed but both the large and small bowel were only bruised and not lacerated. This patient recovered from this wound without the development of a herniation. A case of a railway man crushed between two railway trucks at the moment of a rocket incident is presented. He recovered after 8 feet of small intestine were resected and a laceration of the bowel was sutured. A 12 year old girl recovered after exteriorization of the colon because 5 or 6 inches of the mesosigmoid had been separated from the bowel by the blast of a V2 bomb. A case is presented in which severe damage to the liver and free portions were found in the abdominal cavity. The patient, a 15 year old boy, recovered. A woman recovered from a fragment wound in the right hypochondrium which shattered the eighth and ninth ribs and caused herniation of the liver, gall bladder, and colon through the wound.

Several cases of abdominal injury due to the shelling of Dover are presented. An American soldier recovered from multiple injuries caused by an exploding shell, a fragment of which penetrated his abdomen and passed through both walls of the stomach. Postoperatively, he developed intestinal obstruction and had to undergo a second laparotomy

## INTERNATIONAL ABSTRACTS OF SURGERY

for relief from the adhesions. Subsequent recovery was uneventful. A remarkable plastic result was achieved by Rainsford Mowlem in a case of a woman with a severe perineal wound due to a shell fragment. He successfully reconstructed the vaginal and anal orifices.

A very remarkable recovery of a patient of the author is presented. A 39 year old woman was wounded in the upper left abdomen. The liver and everted stomach were visible through the anterior wound. Through the posterior exit wound, the colon protruded. The patient had numerous other puncture wounds of both legs. At operation, 3½ hours after wounding, several tears in the liver were sutured. The spleen which was pulped was removed, a partial detachment of the diaphragm was repaired, and a 6 inch longitudinal tear in the stomach which led to the turning inside out of the viscous was sutured. The patient ultimately made a good recovery.

ROBERT R. BIGELOW, M.D.

Newson, A., Watson, D., and Rose, T. F.: Early Results in a Short Series of Cases of Gunshot Wounds of the Abdomen. *Med. J. Australia*, 1946, 1: 180

The authors present 27 cases of wounds of the abdomen which were treated in a forward unit in the Southwest Pacific area. The wounds were from 4 to 16 hours old when seen, and were caused by rifle bullets, machine gun bullets, mortar, high explosive, grenade or land mine fragments.

The treatment is briefly discussed, with emphasis on resuscitation by blood transfusions and blood plasma. The operative treatment of the 23 cases requiring laparotomy was not described. The postoperative treatment included gastroduodenal drainage, fluids, plasma, blood transfusions, and penicillin intramuscularly.

Nine patients had solid visceral injuries only. Of these, 6 had an uneventful convalescence. Two patients developed a wound infection and a biliary fistula, but ultimately recovered. One patient with a shattered liver died from irreversible shock.

Eighteen patients had wounds of the bowel. Of these, 5 recovered without complications; 4 had pulmonary emboli or intra-abdominal infection, but recovered; and 9 died (2 from irreversible shock, 1 from traumatic uremia, 1 from a hyperpyrexia, 1 from fatal peritonitis, 1 from an associated penetrating wound of the brain, and 1 following removal of the remnants of his only kidney—congenital absence).

Of the patients who recovered, 10 were back at their regular jobs in from 2 to 3 months, 1 was discharged from the Army as fit for sedentary work, and the other 4 were either in convalescent depots or about to be sent there, 3 months after being wounded.

THOMAS C. DOUGLASS, M.D.

Thornton, T. F., Jr., Storer, E. H., and Dragsted, L. R.: Supradiaphragmatic Section of the Vagus Nerves. *J. Am. M. Ass.*, 1946, 130: 764.

Following extensive studies of the effect of supradiaphragmatic section of the vagus nerves on gastric secretion and motility in patients with peptic ulcer, the authors conclude that:

1. The continuous night secretion of gastric juice in the empty stomach of patients with gastric and duodenal ulcers is usually much greater than in normal man.
2. This hypersecretion is chiefly neurogenic in character, and is much reduced by section of the vagus nerves to the stomach.
3. The empty stomach of ulcer patients often displays a hypertonicity and hypermotility, with exaggerated hunger contractions, and these are returned toward the normal state after bilateral vagotomy.
4. Complete section of the vagus nerves to the stomach in man abolishes the secretion of gastric juice produced by a sham meal or by insulin hypoglycemia, but has little or no effect on the response to histamine or caffeine. The absence of a secretory response to a sham meal or to insulin hypoglycemia is evidence that section of the vagus nerves to the stomach has been complete. CHARLES BROWN, M.D.

# GYNECOLOGY

## UTERUS

Fahlund, G. T. R., and Broders, A. C.: Postmenopausal Endometrium and Its Relation to Adenocarcinoma of the Corpus Uteri. *Am. J. Obst.*, 1946, 51: 22.

The question of whether a given malignant neoplasm passes through a premalignant phase is often raised, and hence should be considered as fundamental. Since the problem obviously is closely allied with early diagnosis and treatment, the question is not purely academic, but practical as well. Thus, if a premalignant phase could be definitely established, physicians could strive to diagnose the condition during this period and eradicate it, with consequent prevention of the malignant neoplasm. The foregoing fundamental question prompted a study of the postmenopausal endometrium and its relation to adenocarcinoma of the corpus uteri.

The material studied consisted of postmenopausal uteri in 236 cases. In 86 of the cases the uterus had been removed because of adenocarcinoma, and in 100 cases it had been removed for other reasons. In 50 cases routine necropsy had been performed.

In the group of 86 women who had adenocarcinoma of the corpus uteri, all but 1 had had vaginal bleeding or spotting as a presenting complaint.

In the 86 cases of adenocarcinomatous uteri, there was no appreciable variation in the percentage of cases with proliferative endometrium, whether early or late, or in the percentage of cases with atrophic endometrium, according to the grade of malignancy.

There was no appreciable difference in the percentage of cases of any given type of endometrium in adenocarcinomatous uteri as compared with nonadenocarcinomatous uteri, except with regard to atrophic endometrium. Thus, 41.8 per cent of cases of uteri with malignancy showed atrophic endometrium, and only 16 per cent of cases of uteri without malignancy showed atrophic endometrium. This suggests that adenocarcinoma of the uterine corpus is more likely to occur in cases in which there is atrophy of the endometrium than in cases in which there is no atrophy.

Two of the 86 cases of adenocarcinomatous uteri, and 3 of the 150 cases of nonadenocarcinomatous uteri presented some features similar to those found in early differentiative endometrium, but since they were not entirely the same the endometrium was classified as late proliferative.

The percentage of cases with cystic change (grades 3 and 4) and with accumulation of secretion (grades 3 and 4) was roughly the same in the two groups of cases. Approximately 42 per cent of adenocarcinomatous uteri showed no cystic changes, whereas 20 per cent of nonadenocarcinomatous uteri showed no cystic changes. This lends evidence which is contrary to the view that the "swiss-cheese endome-

trium" of Novak has any features predisposing to the development of carcinoma.

There was no consistent difference or variation of cystic change, accumulation of secretion in the glands, density of the stroma in and beneath the endometrial epithelium, involvement of the sub-basal glands, or sclerosis of the arteries and arterioles, according to the grade of adenocarcinoma. In 28 of the 86 cases, no sub-basal glands were found. Thus, sub-basal glands seem to have no causal relationship to adenocarcinoma of the uterus.

There was virtually no difference in average thickness of endometrium in adenocarcinomatous uteri, compared with nonadenocarcinomatous uteri.

The incidence of endometrial polypi in uteri without adenocarcinoma was, roughly, eight times greater than their incidence in uteri containing adenocarcinoma. However, previous curettage in all cases of malignancy might be partially responsible for the variation.

In general, it may be concluded from this comparison of adenocarcinomatous and nonadenocarcinomatous uteri removed from women who had passed the menopause, that the uninvolved portion of endometrium in the former group was in no demonstrable way different from that of the endometrium in the latter group except that atrophic endometrium was found more often in adenocarcinomatous uteri than in nonadenocarcinomatous uteri, while endometrial polypi were found more often in nonadenocarcinomatous uteri.

Stowe, L. M.: A Histological Study of the Effect of Irradiation on Adenocarcinoma of the Endometrium. *Am. J. Obst. Gyn.*, 1946, 51: 57.

The literature dealing with the detection of residual tumor and its frequency in adenocarcinoma of the endometrium treated with radium, radon, and deep x-ray therapy was reviewed by the author. The reports show persistence of apparently viable tumor in from 12.5 to 89 per cent of the cases. There was wide variation in the amount of therapy given, in the type of radium or radon applicators used, in the intervals between irradiation therapy and operation, and in the thoroughness of the search for residual tumor in the operative specimens.

The incidence of residual tumor in the uteri of the 53 patients studied was 50.9 per cent. All of these patients were given intrauterine applications of radium; 23 had deep x-ray therapy as well. In a small series in whom x-rays were employed in adequate dosage together with radium irradiation, the incidence of residual tumor fell to 40 per cent, while in a larger series in which radium alone was used, the incidence was 56.5 per cent.

An applicator designed to overcome the effect of variations in size and shape of the uterine cavity is described. It was used in 46 of the 53 cases.

In the majority of instances in which residual carcinoma was found, it was seen in the musculature of the uterus. The significance of this is discussed.

In view of the fact that tumor persisted after irradiation in a high percentage of cases, and especially in view of its frequency in the myometrium, it is concluded that surgical attack must be considered the essential feature of curative therapy in the treatment of adenocarcinoma of the corpus uteri. It is still possible that preliminary irradiation may be useful as additional therapy or for palliation.

EDWARD L. CORNELL, M.D.

Corscaden, J. A., Fertig, J. W., and Gusberg, S. B.: Carcinoma Subsequent to the Radiotherapeutic Menopause. *Am. J. Obst. Gyn.*, 1946, 51: 1.

Among 938 patients treated for benign uterine bleeding by induction of the radiotherapeutic menopause and followed up for an average of 6.7 years each, there subsequently occurred 15 carcinomas of the uterus. Based on the modified mortality statistics, the same number of women in the general population during the same length of time should contract 4.4 carcinomas of the uterus. The observed number of cases is therefore 3.4 times as large as the number expected.

Two and eight-tenths per cent of the women in the general population between the ages of 30 and 55 years contract cancer of the uterus before reaching the age of 80. Applying the ratio of 3.4, we find that 9.6 per cent of the women suffering from uterine bleeding prior to the menopause would contract it.

Of 15 cases, 9 were of the corpus and 6 of the cervix. This abnormal preponderance of carcinoma of the corpus is in agreement with that present in other reported cases in which the ratio is 2 of the corpus to 1 of the cervix. This ratio of corpus to cervix is 6 times that obtaining in the clinic.

It is inferred that the endometria of uteri which bleed abnormally prior to the menopause are predisposed to the subsequent development of carcinoma of the corpus.

Prophylaxis against carcinoma of the uterus should be an important factor in a plan of treatment for uterine bleeding prior to the menopause.

EDWARD L. CORNELL, M.D.

#### ADNEXAL AND PERIUTERINE CONDITIONS

Glanfrant, T.: Neoplasms In Apparently Normal Ovaries. *Am. J. Obst. Gyn.*, 1946, 51: 246.

The author has examined the ovaries at all operations in which this was possible in the service of the Graduate Hospital, Philadelphia, Pennsylvania, and in the past 3 years the following tumors were found in approximately 1,500 ovaries that appeared normal: 3 dermoids, 1 Brenner tumor, 1 fibroma, 1 papillary cyst adenocarcinoma, and 1 granulosa cell tumor. Two of these tumors were discovered in the routine pathological examination of the ovaries removed at operation; 5 of them were found by examination of the ovaries during the operation.

These small neoplasms ranged in size from a few millimeters to 1.5 cm.; none of the ovaries that harbored them were of more than normal size.

These tumors comprise a group of extreme interest in themselves, but a more important consideration lies in the practical aspect of the problem presented by their presence in apparently normal ovaries. Although they were mere infant growths when discovered, they would have enlarged eventually, but their early discovery and removal averted serious consequences.

The 7 cases are briefly discussed.

EDWARD L. CORNELL, M.D.

#### MISCELLANEOUS

Da Silva Pereira, J. M.: Prolapse of the Urethra in the Female; Considerations Based on 3 Personal Observations (Prolapso de uretra feminina, considerações em torno de 3 casos). *Obst. ginec. bras.*, 1945, 3: 848.

The first of these 3 patients was a woman, 67 years of age, with senile involution of the sexual organs. First she had polyuria and later developed such dysuria as to make it necessary for her to urinate with great difficulty in a hot bath. Ten days before examination she noted a tumor of the vulva and began to pass blood with the urine. Examination disclosed an almond sized, cyanotic, bleeding mass at the external meatus of the urethra which had become strangulated at the base. Operation consisted in splitting the collarlike excrescence on both sides down to the base, cutting away the upper flap, and suturing the remaining mucosa to the edge of the meatus with interrupted, fine, chromic catgut. The lower flap was also cut away and the incision extended back along the upper wall of the vagina, deep sutures being then applied, much as in the Hegar perineal repair, so as to produce a narrowing of the urethral lumen. An inlying catheter was kept in position for 5 days and the completed the treatment. A photograph, a month later, shows the condition still perfectly corrected.

The second patient was a child of 9 years, whose condition was discovered in the bath. The operation was the same as in the first instance, except that the lower flap was sutured in the same manner as the upper without an attempt at urethral repair. A half year later re-examination disclosed a perfect result.

The third case, that of a child of 10 years of age was operated upon in the same manner as the second except that the inlying catheter was omitted; nevertheless, the result was as good as in the other case.

The author emphasizes the predominance of the lesion in the extremes of life and the good results to be expected by almost any of the methods of treatment previously proposed, provided that the condition be recognized early, before strangulation and infection render treatment difficult and dangerous.

The classification adopted by the author differs somewhat from those of previous writers on the subject.

ject; first degree prolapse is a prolapse of only a part of the circumference of the mucosa at the external meatus; second degree prolapse is a protrusion of the entire circumference of the anterior section of the urethral mucosa, and third degree prolapse is the protrusion of both the anterior and posterior segments of the mucosal cylinder lining the urethra.

JOHN W. BRENNAN, M.D.

Pérez, M. L., Arenas, N., and Bolla, I.: Immediate and Terminal Results of the Surgical Treatment of Genital Prolapse (Resultados inmediatos y alejados del tratamiento quirúrgico del prolapso genital). *An. Inst. maternidad*, B. Air., 1944, 6: 9.

The authors report on 200 operations for genital prolapse performed in the gynecological section of the Institute for Maternity and Social Assistance in Buenos Aires from 1935 to 1943 inclusive. Seventy cases could be followed up to the present time and these are arranged in a table which makes up the greater part of the article. In all, the results were satisfactory, not a single instance of recurrence being observed.

Sixty-two of the 70 patients were under 60 years of age and in all of these the technique of Halban had been applied; the remaining 7 were more than 60 years old and in these the Le Fort technique had been done. In 7 patients in whom there was some loss of control of the urine a torsion operation on the urethra (2 instances), or the technique of Marion for narrowing the urethral lumen (5 cases) was added. In 1 senile patient the technique used was that of Kahr.

The technique of Halban was followed by preference under low spinal anesthesia with novocain, but occasionally local or general anesthesia was used. In cases of retroversion, the uterus was fixed to the highest part of the vesical peritoneum. Amputation of the cervix was done in 24 of the 70 patients, but only when the uterine cavity measured more than 8 cm. on hysteroecomy. Colpoperineorrhaphy with myorrhaphy of the puborectal muscle slips of the levator ani was performed in most cases; however, this was done only in the presence of a low rectocele with a bad perineal tear.

There was 1 case of death from pulmonary embolism. Three cases developed a postoperative vaginoperineal fistula and 1 case a rectoperineal fistula.

Several of the 200 patients are reported to have passed through a perfectly normal pregnancy, and in 1 of the 70 patients who were followed up a normal pregnancy and delivery was followed by a second pregnancy since the operation, without recurrence of the original condition. JOHN W. BRENNAN, M.D.

De Jaegher, M.: The Adrenogenital Syndrome of the Girl with Pseudohermaphroditism (Sur le syndrome adrénogénital de la fillette a forme de pseudo-hermaphroditisme). *Rev. belge sc. med.*, 1942, 14: 346.

The adrenal cortex exerts a decisive influence upon the harmonious development of the sexual mor-

phology and physiology. This interrelation is also indicated by the names proposed for certain pathological states such as the "adrenogenital syndrome" and similar ones.

If the adrenocortical dysplasia develops in the first months of life, a pseudohermaphroditism results because of the appearance of secondary sexual characteristics from both sexes.

The appearance of an adrenogenital syndrome in the newborn, probably pre-existing during fetal life, affects the development in a much more profound and less reversible manner than the development of this syndrome during puberty or the menopause. Twenty-six cases of infantile adrenogenital syndrome have been reported, 21 of which occurred in girls.

The author reports a case in which the father of the girl had a history of active pulmonary tuberculosis. The girl developed normally up to the age of 15 months; at that time she showed a minimal amount of vaginal bleeding, which her mother considered a precocious menstruation. At the age of 18 months, hair appeared on the large labia, and the latter became hypertrophic at the age of 2 years. The voice turned harsh and a tendency toward masturbation was noted.

At the age of 3 years and 2 months the child was first examined and was found slightly overdeveloped in size (corresponding to 4 years), but with ossifications of the wrist bones, corresponding to age 12, no anomalies of the skull or sella turcica were found. The tuberculin test was positive. The girl was of dark complexion with slightly pigmented spots, dark hair, and bushy eyebrows. A light hair growth was seen on the upper lips, thighs, and calves. The chest was well developed, the pelvis appeared to be masculine, the legs were short with incomplete syndactylism of the second and third toes. The suprapubic region and the large labia were hairy. The large and small labia and the clitoris were hypertrophic with the external urethral opening on the undersurface of the clitoris. The vagina appeared to be of normal size. There was some mental retardation. A roentgenogram of the adrenal regions revealed a calcified tumor of the left adrenal gland. Laboratory findings including urine tests for male and female sex hormones revealed no abnormality.

A clinical diagnosis of calcified left adrenal tumor was made; 2 days after surgical extirpation of the tumor, the child died in shock. The autopsy revealed a recent caseous tuberculosis of the mesenteric ileocecal glands without a visible intestinal lesion and without a pulmonary lesion. The liver showed steatosis. The histological examination of the central nervous system and of the diencephalon was negative. The liver and spleen showed traces of a recent toxic infectious process. One kidney was larger with a normal arterial supply, the other, and smaller, kidney showed a discrete chronic pyelonephritis.

The thymus showed large Hassall bodies, and the thyroid gland showed colloid accumulation. The hypophysis showed a predominance of acidophil

## INTERNATIONAL ABSTRACTS OF SURGERY

cells. The ovaries appeared within normal limits with numerous follicles within the cortical zone and some graafian follicles in the central zone. There was no evidence of any stimulation of the ovaries by the adrenocortical tumor.

The left adrenal gland showed some toxic lesions, and the surgically removed right adrenocortical tumor revealed a microscopic picture which has been described by Goormaghtigh as typical for an adrenocortical tumor with masculinizing effects: (1) the presence of gross granulations arranged within the least atypical cells in halfmoons, which were stained by scarlet red, iron hematoxyline, and, at times, also by acid fuchsin; and (2) the gradual disappearance of the granulations into a marginal lacunar system. Broster has classified the effects of tumors of the adrenal cortex according to the type of tumor, and the age and sex of the patients, as follows:

- Androgenic tumors:
1. In the female child: masculine genital organs and pubertas praecox.
  2. In the female at puberty: masculinization of the genital organs and suppression of ovarian function.
  3. In the male child: pubertas praecox without spermatogenesis.
  4. In the male at puberty, no effects being noticeable.

Estrogenic tumors:

1. In the male child: found to be an extremely rare occurrence.

2. In the male at puberty: feminization, gynaecomastia, impotence, and testicular atrophy.
3. In the female child: pubertas praecox without maturation of the ovaries, but with menstruation in certain cases.
4. In the female at puberty: no discernible effects.

ARTHUR J. LESSER, M.D.

Jones, H. O., and Doyle, L. W.: Studies of Surgical Morbidity. Effect of Prostigmine on the Urinary Tract in Gynecologic Surgery. *Am. J. Obst.*, 1946, 51: 184.

A study of the effect of prostigmine on the urinary tract following gynecologic surgery is presented. Eighty-five patients received the drug and 85 were used as controls. The incidence of postoperative urinary distress was the same in the treated as in the untreated group. The postoperative urinary findings were the same for both groups. The incidence of postoperative spontaneous voiding was the same in both groups.

"Gas pains" were somewhat lessened in the patients who received prostigmine, but in patients in whom obstruction existed, the discomfort was increased by prostigmine. The amount of "residual urine" was found to be the same in the patients who voided spontaneously as in those who had to be catheterized for urinary distress or distention. As used in the authors' study, prostigmine was ineffective in preventing postoperative urinary infections.

EDWARD L. CORNELL, M.D.

# OBSTETRICS

## PREGNANCY AND ITS COMPLICATIONS

Trillat, P., and Notter, A.: Synostosis of the Pubic Symphysis. An Anatomic and Clinical Study (*La synostose de la symphyse pubienne. Considérations anatomiques et cliniques*). *Rev. fr. gyn. obst.*, 1945, 40: 321.

In studying a collection of 181 pelves at the Museum of the Obstetrical Clinic of Lyons, the authors observed a most peculiar anomaly in 1 pelvis, namely, a complete synostosis of the pubic bones. The specimen had been taken from a woman of 47 years and consisted of a symmetrical pelvis; the anteroexternal surface of the pubes and ischiopubic rami were very irregular and the internal margin bristled with exuberant exostoses. A veritable bony bridge connected the upper portion of the pubic bones. The superior synostosis was complete, which was confirmed roentgenologically, but a suture could be observed in the lower portion. Below the articulation, the ossified ends of the arch were plainly visible. The deformities along the margin of the hip bone and anterior surface of the pelvis resembled the lesions of rickets, but the more marked deformities in the inferior ischiopubic region suggested rather the inflammatory sequelae of osteomyelitis.

A search was made of the literature for cases of symphysiotomy in which such an anomaly might have prevented division of the symphysis. Some mention was found in the older literature of such instances, but emphasis was always placed on their extreme rarity. No mention of the condition was found in later literature. The incidence, according to clinical statistics, would be 13 in 670 patients. The authors examined specimens in other museums without success.

Just as the degree of ossification encountered in other articulations may vary, so the symphysis may display various degrees of ossification up to complete synostosis. Other possible etiological factors suggested include surgical injury, coxalgia, and acute osteomyelitic arthritis.

In a normal pelvis like the one described such a synostosis might cause no symptoms, and even labor might not be seriously affected. But in cases of constricted pelvis, such an anomaly would increase the dystocia. Synostosis constitutes a contraindication to symphysiotomy.

EDITH SCHANCHE MOORE.

## NEWBORN

Baldt, E. M.: Hemorrhage of the Suprarenal Glands in the Newborn (*Las hemorragias de las cápsulas suprarenales en el recién nacido*). *An. Inst. maternidad*, B. Air., 1944, 6: 159.

In 32 years of work at this institution, the author observed 10 infants with hemorrhage of the supra-

renal glands. Four of the infants had been borne by primiparas (1 of these had had a previous abortion), and 6 had been borne by multiparas. At periods from a few hours to 11 days following delivery (spontaneous in 7; by forceps in 2; by Kristellar expression in 1) the infants developed symptoms of the "pseudopneumonia of the newborn" of Goldzieher and Gordon (*Endocrinology*, 1932, 16: 165), of icterus and progressive anemia, of cerebral hemorrhage, or of just plain collapse (with or without fever) and died in a few hours or in a few days. The autopsies disclosed little else than the hemorrhagic accident into the right, or into both (in 3 of the 10 cases) of the suprarenal glands.

These 10 not unusual reports of this condition are offered rather less with the thought of adding what is startlingly new to medical experience than to remind us of how little attention has been allotted to the problem of suprarenal hemorrhage, and of how much interesting work has been done, particularly in North America recently. Particular stress is laid on the report of Corcoran and Strauss (*J. Am. M. Ass.*, 1924, 82: 626), in which they stated that recognition of the condition at operation permitted ligation of bleeding artery and recovery of the child, and that the establishment of the clinical syndrome "pseudopneumonia in the newborn," will enable earlier recognition and proper treatment of the condition in many cases.

The author tends to blame this grave accident of the newborn child to a great extent on the innermost layers of the cortical layer of the suprarenal capsule, the so-called "fetal cortex," androgenic zone, or zone X, and particularly on the confused degenerative processes which occur at about the time of the child's birth.

The usual therapeutic procedures for individual manifestations are recommended, such as blood transfusions for anemia, 10 per cent glucose solution for hypoglycemia, and vitamin K for hypoprothrombinemia—low values of the coagulative essential are very apt to be encountered at birth. Although admitting lack of practical experience in the matter, the author believes that, despite some unfavorable reports, the newer and more efficacious preparations of the cortex of the suprarenal gland should be given an adequate trial.

JOHN W. BRENNAN, M.D.

Mayes, H. W.: Cord Transfusions in Newborn Infants. *J. Pediat.*, S. Louis, 1946, 28: 69.

Following a long labor, difficult forceps delivery, or breech extraction, infants are frequently in severe shock. Not infrequently they are suffering from hemorrhage, and shock may not always be apparent at birth but develops shortly after. In premature babies the blood has a low content of vitamin K and prothrombin, and premature infants are much more subject to hemorrhage and will not withstand as



much trauma as full term infants. It would seem that if newborn full term infants following a difficult labor, and all premature infants were given some adult blood immediately following birth, such a transfusion might overcome shock, supply the needed vitamin K and prothrombin, and furnish nourishment and fully developed red corpuscles to be utilized in carrying on the circulatory functions.

Another hazard to the newborn infant is erythroblastosis. It would seem that the Rh factor alone does not determine or is not alone present in the development of the disease. Even more prognostic of its occurrence, particularly when found in infants of Rh-negative mothers, is a high count of normoblasts in the cord blood immediately or soon after birth. Transfusions would seem of value in the actual or prophylactic treatment of erythroblastosis.

Mother's blood is preferred for cord transfusion because at the time of delivery it contains more prothrombin and vitamin K than the average individual's, the vitamin K having been reinforced by administration during labor. If mother's blood is used only once, as is usually the case, it is not necessary to match the blood before giving the cord transfusion. Even if it is incompatible and although there may be some reaction, this one transfusion will assist the baby, since the blood will remain in the circulation long enough to exert its beneficial effect. The reason for this is the absence of agglutinins in the baby's blood at birth other than those derived from the mother.

The blood should be withdrawn before the birth under sterile precautions and placed on the delivery table. A 50 c.c. syringe containing sufficient citrate to insure against clotting in the syringe is used; 5 c.c. of a 2 per cent solution of sodium citrate is enough for 35 c.c. of blood. If 50 c.c. of blood are to be used, then 7 or 8 c.c. of the citrate are advisable. When the citrate is first drawn into the syringe, the entire length of the barrel should be moistened with it by withdrawing the plunger of the syringe and allowing the solution to come in contact with the entire inside of the barrel.

The amount of blood given depends upon the size of the baby and the reason for its use. The correct amount for a baby is about 10 c.c. per pound of body weight.

It is preferable to inject the blood before separating the baby from the mother. The baby is placed on the mother's abdomen or is held with the head down by an assistant. The cord is clamped and the blood injected into the umbilical vein. The cord should be steadied with the left hand, the barrel of the syringe grasped with the right, and the blood injected by making pressure on the plunger with the chest.

Great care should be taken after entering the cord vein. Should the point of the needle perforate the thin walled vein the blood will be injected into the substance of the cord, and a diffuse localized area of hemorrhage will appear. If this happens, the transfusion may be attempted again at a point nearer the

baby's body, provided the first attempt was made far enough away from the navel. It is important to select the first site at a maximum distance, usually about 12 inches, to allow for subsequent trials. A large, short bevelled, Fordyce needle obviates the danger of vein injury.

At times it is advisable to separate the baby from the mother before undertaking the transfusion. The cord is likely to collapse when cut and the veins are hard to identify. If the cord is milked toward the clamp, enough blood can be collected to identify the vein.

The giving of blood seems to have no ill effect on the baby. Frequently the respirations are stimulated, and the baby, previously pale in color, becomes pink.

The first cord transfusion at the Methodist Hospital, Brooklyn, New York, was given in 1940 to a premature infant. The first report on cord transfusions was published in 1944 by the author.

A total of 281 cord transfusions were done from 1940 through March, 1945. One hundred and thirty nine premature infants (37 weeks or under) received cord transfusions of their mother's blood, with 20 deaths; the majority of deaths occurred in infants of less than 7 months' gestation.

Forty-one babies were transfused following long labors or difficult deliveries with no deaths.

The babies of 110 Rh negative mothers received cord transfusions of their mother's blood. There were 2 deaths, both of premature infants.

A study was made of 601 cord smears; 288 contained no normoblasts, while 34 contained more than 15. Among these 34 infants there were 5 deaths and 1 stillbirth. Five of the 6 mothers were Rh positive. 1 was Rh negative. Of the 11 infants of Rh negative mothers in the group of 34, 9 received a cord transfusion, with 1 death, that of a premature infant.

A case is reported in which 90 c.c. of blood from the Rh negative mother of high titer (1:80) were given to her baby for marked jaundice with definite improvement in the baby's condition.

The author recommends cord transfusions to babies born of Rh negative mothers when the mothers have had a previous pregnancy. Use of mother's blood rather than donor's is contrary to the general rule, but so far the mother's blood seems to agree with the babies. Cord transfusions may be useful in anticipation of the development of erythroblastosis in infants of Rh negative mothers, or in its treatment when present at birth.

An addendum to the article states that there have been 117 additional cord transfusions between April 1 and December 1, 1945. Fifty-three of the transfusions were given to babies of Rh mothers, with mother's blood, making a total of 85 such transfusions this year with the loss of no viable babies from these mothers.

The total number of cord transfusions of mother's blood given to babies is 398. Two hundred and three of the babies were premature and 163 were babies of Rh mothers.

ERNEST E. ARNHEIM, M.D.

## MISCELLANEOUS

Wislocki, G. B., and Dempsey, E. W.: *Histochemical Age Changes in Normal and Pathological Placental Villi (Hydatidiform Mole, Eclampsia)*. *Endocrinology*, 1946, 38: 90.

Observations on the occurrence and significance of lipoids, glycogen, iron, alkaline phosphatase, and basophilia in the human placenta have been made previously by the authors. They now add further important cytological and histochemical data regarding not only normal but also certain pathological placentas.

The material used in this study consisted of 10 normal placentas ranging in age from 6 weeks up to term. In addition to these, 2 hydatidiform moles and the placentas from 2 cases diagnosed, respectively, as of severe pre-eclampsia and eclampsia were studied. The material was carefully analyzed, chemically and histologically, according to well recognized and accepted techniques. The results were correlated with previous observations.

The occurrence of acid phosphatase in the placenta is reported here for the first time. It accumulates in the trophoblastic syncytium of the human placenta toward the very end of gestation. It occurs principally in the nuclei of the syncytium and to a lesser extent in the perinuclear cytoplasm. Alkaline phosphatase begins to appear in the syncytium in the first months of pregnancy and increases steadily until term. Thus these two enzymes characterize the ageing placenta; they occur in inverse proportion to cytoplasmic basophilic substance (ribonucleoprotein), which diminishes steadily as the placenta ages.

Iron and calcium are demonstrable in considerable quantities in the first half of gestation in the stroma

of the chorionic villi, where they are mainly deposited just beneath the trophoblastic epithelium. In the same localities and during the same period traces of acid and alkaline phosphatase are also encountered.

In the hydatidiform moles no acid phosphatase and relatively little alkaline phosphatase were found. There was definite histochemical confirmation of the known fact that the syncytium produces steroid hormones. No calcium and only diffuse traces of iron were demonstrable in the villi of the moles, but glycogen was present in both the cytotrophoblast and syncytium in amounts greatly increased over normal. The increases or decreases of these various substances in contrast to the amount of these substances in normal villi are referable to the absence of the fetal circulation and a diminished maternal circulation.

The 2 placentas from the cases of severe pre-eclampsia and of eclampsia were unusual. Both cases were atypical in so far as in each the condition was present at 4½ months of gestation. The chorionic villi were prematurely aged as judged by their cytological and histochemical appearance. Many of the villi showed premature ageing of the syncytium, while a few of the very smallest terminal villi showed complete necrosis of both the stroma and syncytium. Ribonucleoproteins (cytoplasmic basophilia) were prematurely reduced, whereas alkaline and acid phosphatases were appreciably increased. There were also noticeable changes in the amount and distribution of both calcium and glycogen. The decrease in cytoplasmic basophilia associated with a premature increase in phosphatase suggests a possible disturbance of nucleoprotein metabolism in this disease.

L. JAMES TALBOT, M.D.

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ERNEST E. ARNHEIM, M.D.

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L. JAMES TALBOT, M.D.

# GENITOURINARY SURGERY

## ADRENAL, KIDNEY, AND URETER

**Reiselman, S. D.:** Early Amyloid Nephrosis following Compound Bone Injuries. *Vrachebnoe Delo*, 1945, p. 71.

As a rule, amyloid nephrosis is closely related to chronic diseases causing cachexia, especially prolonged suppurative processes such as empyema, bronchiectasis, pulmonary abscess, and osteomyelitis. However, amyloid nephrosis may develop following processes of short duration. This observation is not only of diagnostic but also of great prognostic value because, in spite of the fact that the primary process may subside, amyloidosis may be easily mistaken for a decompensated heart or chronic nephritis and incorrect treatment instituted. On the other hand, early recognition of the pathological process and an attempt to eliminate the primary pathogenic source of the disease may be followed by complete recovery.

The author stresses the fact that albuminuria accompanying amyloid nephrosis is not pronounced, but it is subject to considerable fluctuations. The urinary sediment is poor in formed elements when compared with the same degree of albuminuria in other renal conditions. Edemas are not very pronounced and are more marked in the lower than in the upper extremities. Ascites is infrequent and hydrothorax rare.

When amyloid nephrosis is accompanied by amyloidosis of the intestines, diarrhea appears and the condition may then simulate enterocolitis, avitaminosis, or dysentery.

The author maintains that amyloid nephrosis is much more frequent following compound fracture than is generally assumed. He describes 28 cases in which the complication developed from 2 weeks to 3 months after a compound fracture with osteomyelitis. It would be difficult to believe that all 28 patients had had the amyloid nephrosis before the injury and that none of them had clinical symptoms before the trauma.

**Fort, A.:** Tumors of the Renal Pelvis (Tumores de la pelvis renal). *Rev. med. Rosario*, 1945, 35: 1213.

Tumors of the pelvis of the kidney are being reported much more frequently of late years, perhaps because of the better methods of diagnosis for this condition, developed by urologists. However, these tumors are still rather rare, even in comparison with the tumors of the body of the kidney itself. The author's material comprises only 4 cases in comparison with 14 cases of tumor of the kidney parenchyma. The author classifies tumors of the renal pelvis in general by more or less combining the classifications of Albarrán and Imbert, Marión, and Ewing

as follows: epithelial and conjunctival tumors. The conjunctival forms comprising sarcoma, leiomyoma, and angiosarcoma are here ignored, but the epithelial forms are further classified into papillary and nonpapillary types. The papillary types are then subdivided into benign papillomas and papillary carcinomas, and the nonpapillary or solid types are subdivided into paramamillary epitheliomas and epidermoid or cornified epitheliomas. The hardest to distinguish clinically are the two papillary types, the one benign, the other highly malignant, however, in operable cases the treatment is the same — nephrectomy with removal of the entire ureter because of the frequency of implantation into the lower segments of the urinary tract. In the cases of the solid tumors the operation may be limited to the kidney and that part of the upper ureter which is obviously involved. For the nephro-ureterectomy the author prefers the two stage operation.

In the first of the 4 cases here reported the tumor proved to be of a mixed type, a cornified, or pavement cell, epithelioma which diffusely invaded the kidney parenchyma and the perinephric fatty capsule, and scattered fields of a hypernephroid type of large clear cell. However, both types had given rise to more distant metastases, which had retained the identity of the original tumor.

The second tumor was an infiltrating, i.e., a solid, nonpapillomatous epithelioma made up of cells of polymorphous character; however, some areas evidenced a typical malpighian architecture, and the final diagnosis was that of an infiltrating epithelioma of the excretory passages made up of malpighian or atypical cells.

The third tumor, on ascending pyelography, suggested the possibility of a papillary character; however, on operation it proved to be a solidly infiltrating mass, occupying and replacing the entire lower pole of the kidney, and metastasizing in solid masses down the ureter into the perinephric fatty capsule and, in places, throughout the rest of the kidney parenchyma. The tumor cells were highly polymorphic and the presence of polynuclear giant cells rendered the interpretation difficult. At some points the neoplastic tissue had given rise to pseudoglandular structures with a papillary disposition of the tumor capsule. The final diagnosis was atypical and pseudoglandular epithelioma of the excretory passages.

The fourth patient exhibited clinical (cough, hemoptysis) and x-ray evidence of pulmonary metastasis and was not subjected to operation. All of these patients were more than 40 years of age. All had one or more of the usual findings for this condition: pain and tenderness over the involved kidney, hematuria on that side, a depressed contrast program and excretion of indigo-carmin (chromo-

ystoscopy), and distortion of the ascending pyelographic image, including the already cited instance in which the confused shadow tones and dentate edges suggested the presence of a papillomatous condition. In no instance did the removed kidney exhibit noteworthy distortion of contour. In not one case did the patient live even 4 months following the operation because of pulmonary or generalized metastases.

JOHN W. BRENNAN, M.D.

Hamm F. C.: Angioma of the Kidney. *J. Urol.*, Balt., 1946, 55: 143.

The patient was a 34 year old infantry rifleman who had been in the service  $\frac{1}{2}$  year. He was somewhat "under par" as a result of the severe climatic conditions. His complaints were pain in the back, particularly in the left renal area with typical distribution, radiation anteriorly and downward toward the left testicle. Gross hematuria was observed. The blood was mixed with the urine; it was bright red in color and contained many small clots. No dysuria or frequency was observed, but the record showed that the patient had a temperature of 102 degrees, which responded promptly to the administration of sulfadiazine.

Physical examination revealed a chronically ill male with a sallow color. However, the examination, including abdominal palpation, was otherwise negative.

At cystoscopy bloody spurts of urine were observed coming from the left ureteral meatus. Upon catheterization of the ureters clear urine was obtained from the right kidney, but bloody urine from the left. In the retrograde pyelograms the right kidney was found to be considerably smaller than the left, and, in general, poorly developed. There was also some dilatation of the lower right ureter which suggested the possibility of a previous infection.

The left kidney appeared to be normal in size; if anything, it was slightly larger than normal, but in the upper calyx a small filling defect was observed.

It seemed evident that the lesion was an early neoplasm arising from the epithelium of the renal pelvis, and that under ordinary circumstances this would have been sufficient indication for removing the left kidney and possibly the ureter, but because of the doubtful ability of the right kidney to sustain life, a resection of the upper pole of the left kidney was done.

The specimen consisted of the upper pole of the left kidney, weighing 38 gm. and measuring 16.5 by 3 by 4 cm. The specimen was bisected, which exposed the pelvis and calyces. The usual renal architecture stood out prominently. Immediately contiguous to a papilla of a posterior, superior calyx and apparently arising directly from the pelvic mucosa a small tumor mass measuring about 4 mm. in diameter was found attached to the pelvic mucosa by a broad pedicle.

The mass was dark in color and rough on its superior surface. It was in contact with the sur-

rounding pelvic mucosa, which was somewhat granular, thickened, and of dusky hue. The remaining portions of the pelvic lining revealed no notable alterations, the surface being smooth and pale.

On microscopic examination the tumor appeared as a polypoid mass, the superficial epithelium of which was largely absent and was replaced by a leucocytohemorrhagic exudate in a moderately advanced stage of organization. The pedicle and inferior portion of the mass were covered with transitional epithelium which was continuous with the pelvic epithelium. The stroma was generally dense and fibrous and in places was infiltrated with polymorphonuclear leucocytes including eosinophils. The greater portion of the stroma consisted of widely ectatic vessels resembling a cavernoma.

Many of these vessels were thick walled and fibrous with an endothelial lining. Portions of septa were seen which extended into the lumen as in a cavernomatous mass. Other portions were seen in which the stroma contained an engorged, small, thin walled capillary net. Enlarged dilated vessels were present in the tip of the papilla.

JOHN A. LOEF, M.D.

Squire, F. H., and Kretschmer, H. L.: A Study of the Ureters in Bladder Neck Obstructions. *Radiology*, 1946, 46: 32.

This is a preliminary report dealing with the course of the lower ureters in bladder neck obstruction as observed in intravenous urography. The study is based on a review of 120 films selected at random from the Roentgen Ray Department of the Presbyterian Hospital of Chicago. Since the lower ureters often are not visualized, a rather large number of films had to be examined to find 120 in which their visualization was present.

A normal course of the lower ureters was found in 53 cases (44.16%), 48 (90.56%) of which presented benign obstruction and 5 (9.43%) carcinoma.

In 67 cases (55.82%) the lower ureters had an abnormal course. Of this number, 60 (87.55%) presented benign obstruction and 7 (10.44%) carcinoma.

The following abnormalities were observed:

Right angle turn of the ureter	25
Right angle turn of the ureter (high)	4
Lateral displacement of the ureter	
Marked	7
Slight	2
Looping of the ureter	12
High entrance of the ureter into bladder	4
Low entrance of the ureter into bladder	2
Entrance of the ureter at midline	2
Dilatation of the ureter	
Marked	13
Slight	11
Tortuous ureter	3
Hydronephrosis	6
Normal course of ureter with dilatation	8
Normal entrance of the ureter with lateral displacement	4

T. LEUCUTIA, M.D.

## BLADDER, URETHRA, AND PENIS

Coutts, W. E., and Vargas-Zalazar, R.: Contribution to the Etiology of Acquired Fibrosis of the Bladder Neck. *Brit. J. Urol.*, 1945, 17: 136.

The authors state that fibrosis of the vesical neck is characterized by the proliferation of fibrous tissue in the submucosa and into the muscle fibers of the internal sphincter. The entire circumference of the neck of the bladder may be transformed into fibrous tissue, producing a contracture of this structure or only of its inferior portion, sometimes as far back as the trigone; thus a median bar is produced. The disease is congenital or acquired. The acquired form is much more common in adults and is usually confined to the posterior region of the vesical sphincter and trigone. It may arise from trauma, chronic infections of the posterior urethra and prostate, and, in women, from vaginal cervical parametria or perirectal tissues. It is believed that acquired fibrosis is a first stage of submucous and muscle-layer invasion by an infecting agent, and that the virus of lymphogranuloma venereum is the cause in many cases.

Panendoscopy and cystourethrograms are of value in the diagnosis. In the cystogram, the image is similar to that seen in suprapubic prostatectomy.

The authors report 3 cases in which lymphogranuloma virus macroforms in extracytoplasmic plaques were found in tissue removed from the bladder neck with a resectoscope. In their opinion the pathogenic agent invades the bladder neck tissues along the mucous and submucous lymphatics and, based on clinical, laboratory, and histoviral findings, lymphogranuloma venereum virus is a frequent cause of partial or total acquired fibrosis of the bladder neck.

DAVID ROSENBLUM, M.D.

Cristol, D. S., and Broders, A. C.: Malacoplakia of the Bladder. *J. Urol.*, Balt., 1946, 55: 260.

The cause of malacoplakia of the bladder is unknown. A careful search for acid-fast organisms in the specimens of bladder removed for biopsy in the 2 cases reported by the authors gave negative results. No clinical evidence of tuberculous infection could be found in these cases. *Escherichia coli* was cultured from the urine of both patients.

Grossly or cystoscopically the characteristic lesions appear as plaques which vary in number, size, and distribution. The edges of the plaques appear to be abrupt or slightly overhanging. Very often a zone of hyperemia surrounds these lesions. The centers of the large plaques often appear depressed or umbilicated. Frequently, the epithelium appears to be ulcerated over the center of the lesion.

The principal cellular elements are large oval or polyhedral cells, frequently closely aggregated and found in the submucosa. These cells vary in size, but generally are at least as large as a hepatic cell. They have a well defined cell membrane and are for the most part mononucleated. Often the nucleus has disappeared or its presence is marked by the so-called cell inclusions. While the cytoplasm appears

vacuolated in places, it is most characteristically granular. Within the cytoplasm of many of these cells, as well as between many of the cells, can be seen the Michaelis-Gutmann bodies or "inclusion bodies." These vary in size, shape, and number. In size they range from 1 or 2 microns up to bodies so large as to occupy the entire cell. They have a strong affinity for hematoxylin, which stains them purple. For the most part, they are homogeneous and highly refractile. The smaller forms are round or oval but the larger forms show fine crenations or irregularities. Many of them show a definite concentric lamination suggesting corpora amylacea. When stained with the Kossa stain they reveal a high calcium content.

The majority of the patients are women more than 30 years of age who give histories of having suffered frequent bouts of cystitis. However, all age extremes in both sexes have been described.

Urinary frequency and gross hematuria are the most prominent symptoms. The diagnosis rests on the finding of the characteristic lesions and the removal of a portion of the diseased tissue for microscopic examination. The microscopic picture, as previously described, establishes the diagnosis.

The cases of malacoplakia so far reported are too few for the treatment to be standardized. The authors agree with Blum, Folsom and Dickson, Gray and Kidd, in reporting fairly good results following fulguration.

Cordonnier, J. J.: Fistula of the Penile Urethra. *J. Urol.*, Balt., 1946, 55: 278.

The subject of fistula of the penile urethra has assumed added importance since the advent of the present war. Plastic repair of this condition has always presented considerable difficulty, and numerous plastic procedures have been recommended for the purpose of repairing this defect. Although stainless steel "pull out" sutures have been widely used in other locations, no mention of their use in this connection has been found in the literature. A series of 3 cases is presented for consideration. Good results were obtained in all of these cases, with prompt healing of the operative wounds, without infection, and it is believed that the method described is superior to the methods previously presented.

The use of sulfadiazine and penicillin in combination, both preoperatively and postoperatively, has undoubtedly played a very important role in the successful conclusion of these cases. Infection has always been the principal problem in a repair of this nature and, by the use of these two drugs in combination, is practically eliminated. All 3 cases healed without any signs of wound infection.

Diversion of the urinary stream is an essential step prior to operation. It is believed that a suprapubic cystostomy is preferable to perineal urethrostomy. The presence of repeated nocturnal erections, which seemed to be due to irritation of the posterior urethra by the catheter, presented a definite hazard to the success of both operations when an external

urethrostomy had been done. Although urethrostomy is a much simpler technical procedure, the additional operative work required by cystostomy is warranted for this reason alone. Drainage of the bladder by urethral catheter, with the inevitable accompanying urethral infection, is contraindicated.

It is believed that simplicity of procedure is an important factor in any plastic procedure for the repair of urethral fistula. The use of scrotal flaps, skin grafts, and other complicated procedures are generally unnecessary, and only serve to add additional hazards to obtaining a successful result. A careful elevation of the skin flaps around the incision will ordinarily allow closure of the wound without tension.

Careful handling of tissue is undoubtedly important in any plastic repair of this nature. To minimize trauma, small hooks are used throughout, instead of thumb forceps. Plain catgut (0000) on an atraumatic needle is used for all sutures except the skin. The use of the No. 36 stainless steel wire "pull out" suture is probably the most important single step in bringing about a successful closure. It permits the use of *finer catgut than would be possible otherwise*. The advantage of fine catgut in a potentially infected area is self evident. In addition, all tension is removed from the suture lines.

The use of a pressure dressing to prevent the formation of hematoma under the elevated skin flaps is advisable in certain cases. Meticulous wound care must be observed at all times. The topical use of 1:500 penicillin as a urethral instillation has been of value. Periodic urethral dilatations must be maintained for a period of time to prevent stricture formation.

A method of repair utilizing stainless steel "pull out" sutures is described. The procedures outlined are simple to perform. Postoperative convalescence is short and the results have been excellent.

JOHN E. KIRKPATRICK, M.D.

## GENITAL ORGANS

Borthwick, W. M.: *The Pathogenesis of Tuberculous Epididymitis*. *Edinburgh M. J.*, 1946, 53: 55.

Borthwick studied the pathogenesis of tuberculous epididymitis by examining the records of 5,476 tuberculous males admitted to the hospital during a period of 21 years, and 402 (7.3%) had involvement of the epididymis by tuberculosis. The corrected true incidence is probably 4.5 per cent. The youngest patient was 8 months old and the oldest was 63 years old.

Male genital tuberculosis occurs most commonly during the years of maximal sexual activity. In 88.3 per cent of the patients at least one extragenital tuberculous lesion was proved. Injury appears to have little influence in the production or localization of the genital disease. Gonococcal epididymitis had little or no influence on the occurrence of tuberculous epididymitis. The lesion was unilateral in 43.5 per cent of the patients and bilateral in 56.5 per cent.

Recurrence occurred within 1 year in 74.6 per cent, and in 58.7 per cent the disease became bilateral within 6 months. Negative rectal findings were present in 12.7 per cent. The remainder (87.3%) were "rectal positive." The author received the impression that, no matter how early the tuberculous epididymitis, a lesion of the pelvic genitalia could be felt rectally in the great majority of patients, and that vesiculitis or prostatitis, or both, precedes the more peripheral genital lesion.

Renal tuberculosis also was present in 34.8 per cent of the patients. Men with epididymal tuberculosis in whom tubercle bacilli cannot be isolated from the kidney urine are extremely few in number. The author believes that renal tuberculosis precedes epididymal tuberculosis in the great majority of cases. Tuberculous prostatitis and vesiculitis precede epididymitis; *the globus minor is the first part to be affected, and in testicular disease the maximum involvement was at the mediastinum testis*.

The author is satisfied that the sequence of events in genitourinary tuberculosis is from the kidney to the pelvic genitalia and from there to the epididymis. The spread of tuberculosis to the epididymis takes place in the majority of cases by the lumen of the vas deferens. The great majority of patients with tuberculous epididymitis have or have had a tuberculous bacilluria from a clinical or subclinical lesion of the kidney. In almost every case of tuberculous epididymitis in the present series, with or without urological symptoms, tubercle bacilli have been isolated from the kidney urine. Infection of the prostate and seminal vesicles probably takes place by urine transmission, by heavy work, straining, and the very act of micturition. DAVID ROSENBLUM, M.D.

Mansfield, O. T.: *Spontaneous Gangrene of the Scrotum (Fournier's Gangrene)*. *Brit. J. Surg.*, 1946, 33: 275.

Mansfield reports a case of spontaneous gangrene of the scrotum in a man 43 years of age who was admitted to the hospital with an entirely gangrenous scrotum. This was removed, except for 3 triangular flaps at the base which seemed to retain viability. Two of these were based laterally and 1 posteriorly, and between them both testes lay completely exposed. Section of the removed tissue showed marked interstitial edema with many thrombosed vessels. The patient's condition rapidly improved after operation, and epithelization was complete in 6 weeks.

Fournier first described the condition in 1844, noting the explosive onset in a healthy man, the rapid progress of the gangrene, and the total absence of the usual causes for gangrene. Further reports in the literature describe the extensive and fairly constant area of gangrene with integrity of the testes and inguinal and anal regions, rapid resolution of the adjoining cellulitis, and a tendency for spontaneous repair.

The author believes that the condition is a vascular disaster of infective origin analogous to cavernous sinus thrombosis. The fairly constant pattern of the



sloughing area is adequately explained on a vascular basis which would account for the existence of the described flaps. The latter are supplied by the external pudendal branch of the femoral artery and superficial perineal arteries. The rapid gangrene is comparable to that of a flap of skin which has become infected and its limited vascular supply destroyed by thrombosis. Therefore, treatment should consist of radical removal of all sloughing areas, sulfonamides, and penicillin. Repair seems unnecessary. Reports in the literature indicate that death in most instances has been due to toxemia. The bacteriological agents have been streptococci, staphylococci, or both.

DAVID ROSENBLUM, M.D.

Bertelsen, A., and Wandall, H. H.: Vasoseminal Vesiculography and Its Clinical Application. *Acta radiol.*, Stockholm, 1945, 26: 36.

Following a brief résumé of the literature on vesiculography, the authors report 16 of their own cases in addition to some work on rabbits to show the irritative effects of hippodin (a 50 per cent solution of sodium orthoiodine hippurate) as compared to the innocuous preparation, perabrodil (3-5-diiodide-4-pyridon-N-diethyl-amine acetate).

The experimental work showing the irritative qualities of hippodin was done on the vasa of rabbits which were injected close to the testicle and sections of the vasa were removed at 2, 4, 10, 14, and 21 day intervals for microscopic study. On the second day the vasa injected with hippodin showed round cell infiltration, especially eosinophilia in the wall of the vas, whereas the epithelium of the vas was well preserved everywhere. The specimens of the fourth day showed complete epithelial desquamation and slight submucosal fibrosis, and by the fourteenth day there were no pathological changes. On the other hand, the rabbit vasa injected with perabrodil showed no changes at anytime from 2 to 28 days after injection.

Of the 16 patients subjected to vesiculography, 6 were examined at vasectomy and 10 were examined for diagnosis of genital diseases. The conditions found were as follows:

Aspermia (1); oligospermia (1); groin and testicular pain following herniotomy (2) . . . . .	4
Aspermia following testicular trauma . . . . .	1
Sequel of epididymal resection . . . . .	1
Undescended testicle . . . . .	2
Vesiculitis . . . . .	2

In 3 cases of herniotomy by the Bassini method there was obstruction to the vas where it entered the inguinal canal. In the 2 patients with undescended testicles the vas was extraordinarily tortuous, but no variation in vasa caliber was evident. In the 2 instances of operatively proved seminal vesiculitis there was no evidence of dilatation of the canals nor retention of the contrast media. In 3 instances (1 with undescended testes, 1 with trauma to the testicle, and 1 with an epididymectomy with an infection) there was demonstrated an insufficient development of the seminal vesicles and this the authors explained on the basis of disuse.

In the opinion of the authors, the use of vesiculography for diagnostic purposes is warranted by the following:

1. Aspermia in the presence of preserved testicular function.
2. Seminal vesiculitis
3. Adults (not children) about to have an orchidopexy to reveal the presence of sufficient length of the vas deferens
4. Patients with groin or testicular pain following herniotomy with the vesiculogram demonstrating the presence or absence of constriction of the vas at the operative site.

ROBERT LICH, JR., M.D.

## MISCELLANEOUS

Moore, T.: True Infective Abacterial Pyuria. *Brit J Urol.*, 1945, 17: 131.

The author describes "true infective abacterial pyuria," a syndrome which has been experimentally transmitted to animals and apparently caused by a virus infection. The mucosa of the posterior urethra, bladder, or upper urinary tract is affected. The infection resists all forms of treatment except intravenous arsenobenzole drugs. In the renal pelvis the mucosa is thickened and edematous; it shows varying degrees of erythema, and flakes of lymph adhere to it. The submucosa is infiltrated with mononuclear cells, sometimes aggregated into follicles. No organisms are seen. There is no disease of the renal substance. The onset is acute or gradual. There is frequency, dysuria, and sometimes hematuria, with little or no disturbance of the general health. The urine contains many leucocytes, but microscopic examination and culture fail to demonstrate organisms.

Intravenous urography shows some dilatation of the pelvis and ureter, and sometimes small filling defects due to follicular pyelitis and ureteritis. Cystography shows a tiny contracted bladder with an irregular outline. Cystoscopy shows generalized severe nonspecific inflammatory changes, with none of the characteristic appearances of urinary tuberculosis. Tubercle bacilli are never found. There are no constitutional changes, no loss of weight, and no urographic evidence of renal damage. In doubtful cases the therapeutic test is of value.

The course of abacterial pyuria is prolonged and the bladder capacity becomes progressively reduced. The administration of an organic arsenic preparation, such as novarsenobenzole, causes rapid improvement and cure. The author usually administers .3 grams intravenously at intervals of from 5 to 7 days. Normally, four doses are sufficient. A case report is given.

DAVID ROSENBLUM, M.D.

Flocks, R. H.: "Early" Calcium Urolithiasis. *J. Am. M. Ass.*, 1946, 130: 913.

It has been shown that calcium urolithiasis is likely to occur in conditions in which immobilization of the individual is present, in which portions of the

TABLE I.—PREVENTIVE TREATMENT OF CALCIUM PHOSPHATE UROLITHIASIS IN PATIENTS WHO ARE EXTENSIVELY IMMOBILIZED OVER LONG PERIODS OF TIME

Measures	Accomplishes	Comment
1. Maintenance of large fluid output	a. Counteracts stasis by producing a steady flow of urine b. Diluted calcium concentration especially important during period of hypercalcinuria (first 6 to 12 weeks of immobilization) c. Minimized likelihood of infection d. Washes out debris and small calcium precipitates	a. Measure intake and output carefully; remember in cases of neurologic involvement that residual urine may cause inaccuracy in output measurement
2. Control of diet High vitamin A and B acid ash diet usually used	a. High vitamin A and B improve epithelial nutrition b. Increase acidity of urine; calcium phosphate is more soluble in an acid than in an alkaline urine	a. Check urinary pH daily with nitrazine paper b. Discontinue acid ash diet if urine remains alkaline from any cause such as infection with urea-splitting organisms
3. Control of stasis a. Movement of patient b. Provision of adequate drainage by catheter or surgery if necessary c. Maintenance of a large fluid output	a. Makes sure that no portion of urinary tract is dependent or undrained for too long a time b. Minimizes infection c. The use of a catheter makes possible irrigation of pelvis or ureter with special solutions such as citric acid and malic acid solutions	
4. Control of infection a. Maintenance of large fluid output b. Adequate drainage c. Chemotherapy: 1. Sulfacetimide 4 gm. daily in drug of choice 2. Sodium sulfathiazole 4 gm. daily 3. Other sulfonamide 4. Neosarsphenamine 0.3 gm. two times weekly in some staphylococci infections 5. Penicillin, very useful	a. Decreases particles in urine (pus and epithelial debris, which may act as nuclei for stone formation) b. Infection with urea-splitting organism produces alkaline urine, which causes precipitation of calcium phosphate	a. Watch urine pH with nitrazine paper b. Study centrifuged urine specimen daily for pus cells
5. Continuation of treatment for 3 months after immobilization has ceased	To remove any small precipitation which may have formed during period of stasis and hypercalcinuria	
6. Frequent radiographic check-up examinations during illness and every 3 months for one year after immobilization has ceased	This is very important; small precipitates may not be visualized in early urograms but may be visualized later after they have grown; many stones (especially in patients with neurologic lesions) may be silent for years and thus produce irreparable damage unless they are visualized by x-ray examination and treatment instituted	

Note: Henline has shown that the emptying time of the renal pelvis is greatly increased by a small urinary output and decreased by a large fluid output (Lowsley and Kirwin. Clinical Urology).

urinary tract are paralyzed, and in which obstructions and infections of the urinary tract occur, or in which pronounced dehydration is present. There are three probable mechanisms involved in the formation of stone in these situations: infection, stasis, and hypercalcinuria. Multiple small precipitates of calcium phosphate are present in the calices and pelvis of the kidney. These small stones may all pass; they may fuse to form larger stones, or may act as the

nucleus for larger stones; and they may be silent for long periods of time, during which considerable damage to the urinary tract occurs. In the first 6 or 8 months after the onset of the predisposing conditions, before the stones have become intimately mixed with organic material and definitely solidified, the situation may be called "early" calcium urolithiasis. Because this condition is frequently silent, repeated roentgen examinations are necessary.

TABLE II.—CONDITIONS PREDISPOSING TO CALCIUM PHOSPHATE UROLITHIASIS

1. Disease producing prolonged immobilization of the body:
  - a. Fractures of the spine or extremities associated with prolonged immobilization of large bones.
  - b. Chronic osteomyelitis
  - c. Chronic arthritis or other bone joint disease producing immobilization of large portions of the skeleton
  - d. Neurologic damage as a result of trauma or disease producing prolonged immobilization
  - e. Chronic visceral disease requiring prolonged recumbency
2. Changes in the urinary organs:
  - a. Congenital anomalies associated with stasis
  - b. Acquired obstruction—stricture of urethra and the like
  - c. Paralysis of urinary passageway
  - d. Introduction of infection into urinary tract
  - e. Foreign body in urinary passageway
3. Endocrinopathies:
  - a. Hyperparathyroidism
  - b. Hyperthyroidism?
  - c. Hyperpituitary disease?
4. Focus of infection elsewhere in the body?
5. Vitamin deficiency or excess
  - a. Vitamin A deficiency?
  - b. Vitamin D excess
6. Metabolic abnormalities
  - a. Idiopathic hypercalcaemia
  - b. Changes in colloids?

Note: Conditions with question mark are put in mainly on a theoretical basis. Others are put in on the clinical basis.

Special types of treatment are necessary because of the peculiar character of these stones. Later symptoms may be hematuria, ureteral colic, infection (due to stone obstruction) resulting in pyuria, chills, fever, leucocytosis, and renal pain.

When infection is not present and no renal damage has yet occurred ("early phase"), the stone is ideal

for dissolution by means of a combination of fluids, diet, and irrigation therapy. When infection commences, the stones grow more rapidly, calcium phosphate precipitates in the tubules, and the tips of the pyramids become ulcerated and sometimes calcified. If adequate drainage cannot be instituted by ureteral catheter, open surgery must be done. In addition, supportive treatment, chemotherapy, and irrigation should be carried out. In chronic cases the kidney pelvis and calices become distorted from infection, which results in a disturbance of peristalsis, poor drainage, and ready recurrence.

When a case is seen early, there is a typical irregular opacity suggesting depositions of calcium salts usually around the pyramids in the calices. When severe infection is present, there is evidence of consolidation of the calcium particles into definite stones, and dilatation of the kidney pelvis, infection, and obstruction. In late cases the stone shadows are much more dense, there are extensive changes in the calices, kidney pelvis, and kidney, and the condition has passed to the state of late calcium urolithiasis.

With regard to treatment, the author states that because the stone in early calcium urolithiasis is soft and mushy, surgical measures usually fail. If consolidation has not occurred, irrigation therapy through a ureteral catheter, double ureteral catheter, nephrostomy or pyelostomy tube, with acetic acid solutions, citrate solutions, citrate solutions with magnesium oxide, malic acid solutions, and solutions containing proteolytic enzymes, will usually break up the particles and cause them to pass. Infection is controlled by sulfathiazole, penicillin, fluids, and adequate drainage. Open operation is contraindicated in early calcium urolithiasis, until irrigative treatment has been given a thorough trial, and, if open operation is performed, postoperative irrigation through a pyelostomy or nephrostomy tube is of value.

DAVID ROSENBLUM, M.D.

# SURGERY OF THE BONES, JOINTS, MUSCLES, TENDONS

## CONDITIONS OF THE BONES, JOINTS, MUSCLES, TENDONS, ETC.

From, S. A.: On the Incidence of Osteochondrosis. *Acta radiol.*, Stockh., 1945, 26: 49.

In cases of osteochondrosis the roentgen examination of the lumbar spine shows a characteristic narrowing of some intervertebral disc, most often the 5th lumbar. It is accompanied by osseous changes in the form of sclerosis of the borders of the vertebral bodies involved and typical exostosis formation on the anterior border of one or both of these bodies. In some cases this finding is complicated by a displacement of the two bodies in relation to each other, which gives the appearance of spondylolisthesis. These changes are typical of osteochondrosis.

The process begins with a diminution of the fluid content of the nucleus pulposus, and later the x-ray shows cracks and fissures running in all directions. As the process progresses the nucleus shrinks and the size of the disc diminishes. The annular fibrous ring remains intact, although the fibers of the ring become slack, and thus the possibility arises for the vertebral bodies to become slightly dislocated in relation to each other. To the continuous small traumas to which their surfaces thereby become exposed, they react by sclerosis. All of the secondary changes here described may not be found in all cases. A diminished disc as the only finding is of no value whatever, especially in the case of the 5th lumbar disc, because normal variations in the shape and position of the 5th lumbar vertebra vary considerably. In young individuals spondylolysis deformans may be present. This disease shows degeneration in the peripheral part of the disc and the fibers of the annular ring. The fibers break, the disc bulges outward, and there is pressure on the anterior longitudinal ligament. A beak-shaped exostosis develops, distinguished from the exostosis which develops in uncomplicated cases of osteochondrosis. The differential diagnosis rests between acute and chronic inflammations and malignant tumors, but in these cases there is a marked thinning of the bone due to the loss of calcium salts.

One hundred and thirty-two patients were used for this study. In 20 of the cases there was a characteristic picture of osteochondrosis. In 18 of the 20 cases the location of the lesion was in the 5th lumbar disc; 11 of the 20 patients were men. Twelve of the 20 patients were between 40 and 59 years of age. Fifteen of the 20 had been admitted to medical services for various reasons. One often sees marked spondylolysis deformans associated with very few symptoms. A control group of 63 patients was studied. Two of these patients showed typical findings of osteochondrosis. In patients with complaints referable to the vertebral column, frequency of osteochondrosis is ten times greater than in the controls.

The characteristic roentgenological changes in cases of osteochondrosis were: (1) narrowing of the disc and marginal sclerosis in all 22 cases; (2) liplike marginal exostosis in 19 cases; and (3) displacement of the bodies of the vertebrae in relation to each other in 6 cases. In 4 of the 6 cases of displacement, the body of the upper vertebra had slid forward, and in the 2 others it had become displaced backward. In these 6 cases the other three characteristics were present. Air myelography was done in 7 of the 20 cases in which there was osteochondrosis. In all 7 cases the findings were positive, and in 6 of the 7 cases the findings were verified at operation. Only by air myelography is it possible to ascertain whether a prolapse of the nucleus exists.

RICHARD J. BENNETT, JR., M.D.

Einarsson, F.: On the Treatment of Dupuytren's Contracture. *Acta chir. scand.*, 1946, 93: 1.

The author reviews the literature from the earliest description of Dupuytren's contracture by Sir Astley Cooper in 1822, to the present time, and tabulates cases to show the preponderance of males with either right hand or bilateral involvement.

The pathological change is in the palmar aponeurosis where increased vascularization and round cell infiltration in proliferating connective tissue gives way, in time, to a tendonlike cord, and gradual contracture of this cord causes severe flexion deformity of the fingers usually on the ulnar side of the hand. Deep extension of the process may surround the vessels and nerves, but the flexor tendons themselves are never included in the pathological process. Subcutaneous fat and, sometimes, palmar skin degenerate into this fibrous tissue. (Plantar fascia may be similarly affected, and the lesion is localized to the tibial portion of the aponeurosis.)

Many surgical procedures have been advanced to offer relief to the patients. All have been directed toward excision of all or part of the palmar aponeurosis, division of the palmar aponeurosis, or digital amputation. Various types of procedure are outlined, and several palmar approaches are illustrated. The consensus of opinion is that incision must be adapted to the individual case, but should, as nearly as possible, follow the palmar creases. Great care must be taken to avoid injury to the embedded vessels and nerves which may be widely displaced.

The prognosis must be guarded as to recurrence, which is frequent, and tender or insensitive fingers may be handicapping in the absence of recurrence.

During a period of 16 years in the Orthopedic Hospital in Copenhagen, 164 hands of 111 patients were treated for this condition. The cases were classified according to Meyerding's grading, and a total of 84 hands were operated upon. The surgery performed was partial excision of the palmar aponeurosis and/or digital amputation.

Over the period covered there was an increasing tendency toward wide excision rather than simple section of the contracting bands. Only 7 cases required skin grafting, all of which "took" and healed satisfactorily. The usual dressing consisted of dry gauze and a sea sponge compression bandage, with or without extension splinting of the fingers. Active motion was instituted after removal of the skin sutures on the 14th day, and restoration of function was facilitated by the use of warm baths, exercise, iontophoresis with potassium iodide, and other physical therapy.

A follow up of 62 hands over a period from 6 months to 12 years showed 43 cases, or 69 per cent, to have excellent results; 7 cases, or 11 per cent, with fair results; and 12 cases, or 20 per cent, with poor results.

Indications for operation are (1) mild cases occurring in early life when excision of the palmar aponeurosis of the 3 ulnar fingers is prophylactic against the sure slow progression of the disease; (2) severe cases in mature life if the patient is handicapped by deformity and gives reasonable promise of being able to heal a surgical wound. Excision of the aponeurosis or amputation of the affected finger with excision of the adjoining aponeurosis are to be determined upon the merits of each individual case.

Case reports on 12 patients exhibiting poor post-operative results are appended.

FRANCES E. BRENNCKE, M.D.

Frostad, H.: Rupture in the Aponeurosis of the Shoulder Joint; Particularly Referring to Its Treatment. *Acta chir. scand.*, 1946, 93: 33.

The 243 arthrographically studied shoulders and 64 shoulders studied at autopsy are classified as to the type and extent of the damage to the aponeurosis. Of the 76 with complete rupture, 23 were operated upon by the author and these form the material for this article. Codman's criteria for classification are discussed and accepted.

The incidence of rupture of the aponeurosis of the shoulder is greatest in men and women from 40 to 65 years of age and usually with a history of recent trauma. This may have been a fall directly upon the shoulder or the partly abducted arm, or a heavy strain in the long axis of the arm. Calcified deposits have been found in some ruptured tendons, and obviously predispose toward rupture. Findings indicate that the damage must often antedate the trauma which acutely calls attention to the shoulder.

Surgical inspection of recent ruptures shows either broad retracted tendon stumps suitable for suture, an absent peripheral stump with roughened bone marking its previous insertion, or avulsion of a portion of bony tubercle with the tendon. The latter finding is more frequent in younger patients, and the avulsed portion usually reattaches itself more readily if the bony fragment is sizeable.

In chronic cases the tendon stumps atrophy, and the irregular bony prominence of the tubercles and adjacent surface of the humeral neck is exaggerated

by the loss of bony substance in the intervening areas.

Symptoms of a fresh rupture are primarily post-tenderness over the site of the tear, and great pain on attempted abduction of the shoulder. A chronic rupture presents more generalized pain, decreased mobility, with often crepitation on motion, and some degree of atrophy. Arthrography may be necessary to make the differential diagnosis from other shoulder lesions. Communication between the bursa and joint indicates complete rupture, and defects on the under surface of the aponeurosis indicate an incomplete rupture. Often atrophy and erosions are seen in the region of the humeral neck and tubercles.

Treatment aims to relieve pain, re-establish mobility of the shoulder joint, and restore strength to the arm. Conservative treatment usually suffices for incomplete tears as the edges gradually smooth off and as pain disappears the mobility increases. It is imperative that the patient continue active motion from the start to avoid secondary rigidity. Occasionally a week's rest on an abduction splint may be required for the relief of pain.

If complete rupture occurs and conservative treatment is not adequate, surgery is indicated. Suture is the desirable procedure in a recent trauma when there is sufficient stump at each end to provide a good hold for the suture. As late as two months after trauma, suture has yielded a good result. A direct lateral incision, splitting the deltoid fiber lengthwise and opening the roof of the bursa, give adequate exposure and facilitates early resumption of motion. An abduction splint is used for from 1 to 5 weeks, passive motion is begun in 1 week, and active motion after 3 weeks.

In old tears the methods of Wilson, Hjort, and Strom have been used. The author describes these methods and then presents his own simpler operation, intended chiefly to restore a smooth surface to the humerus which will glide beneath the acromion without pain. The approach which has been described is used, and all irregular areas of bone or tendinous stump are planed off, particularly in the region of the tuberosities. In recent ruptures in which good stumps are present, suture is done also. The more radically the smoothing off of the humerus is done, the better the result. A few sutures in the deltoid fascia and the skin suffice for closure.

Passive motion is started the day of operation and often is painful for the first 3 or 4 days. No splint is used, the patient resting his arm on his side for comfort. Active motion should be started on the fourth day and increased as the wound is healed. The average hospital stay in 10 cases was 16 days.

Re-examination from 6 months to 12 years following operation showed that 9 patients worked full time from 2 to 4 weeks after leaving the hospital and 1 patient worked 2 months after leaving the hospital. In 7, normal range of motion was present; 3 had slight limitation of motion; 2 had occasional pain; and 8 had no pain. The strength of the involved

shoulder equalled that of the opposite one in 5 patients and was reduced but good in the other five.

The 7 patients whose ruptures were sutured had longer hospitalization, from 5 to 10 weeks, and returned to work in from 2 to 5 months postoperatively. The range of motion and strength of shoulder were similar to the former group, and the patients had no pain. In each group a single patient developed an articular fistula which closed spontaneously in 3 weeks.

The advantages of simplicity of operation, avoidance of prolonged immobilization, and early return to work, with relief of pain and improvement of both the mobility and strength, recommend this method of treatment.

FRANCES E. BRENNER, M.D.

## SURGERY OF THE BONES, JOINTS, MUSCLES, TENDONS, ETC.

Boppe, M. and Leroy, M.: Results of Stabilizing Operations on the Bones in Paralytic Feet, with or without Transplantation of the Tendons (Résultats des opérations de stabilisation osseuse ou associées aux transplantations tendineuses dans le traitement des pieds paralytiques). *Rev. chir.*, Par., 1945, 64: 145.

The authors report on 78 cases of stabilization of the bones in paralytic feet, discussing the technique of the different operations in detail, and giving the indications, the causes of failure, and the final results.

The best age at which arthrodeses or arthroereises should be done is between 12 and 13 years. At this time the chances of obtaining good ankylosis are best, and there is little danger of secondary deformity caused by abnormal pressure and muscular traction during the growth of the bones. Under the age of 9, arthrodesis is strictly contraindicated.

The failures consist in fibrous pseudarthrosis, fracture of the bone grafts, or secondary deformity.

In 22 of the 78 cases, transplantation of the tendons was done in addition to the bone surgery, partly at the same time, and partly some months after the arthrodesis. The last method gave the best results.

The detailed discussion of the various surgical procedures should be read in the original article.

WERNER M. SOELMITZ, M.D.

## FRACTURES AND DISLOCATIONS

Do Amaral, A. C.: The Treatment of Fractures of the Neck of the Femur by the Brazilian Method of Godoy Moreira—Extra-Articular Nailing (Tratamento das fraturas do colo do fêmur pelo método brasileiro de Godoy Moreira—aparafusamento extra-articular). *Rev. méd. Municipal*, 1945, 6: 245.

This article includes an extensive review of the problem of femoral fractures, with special consideration of those involving the femoral neck, and describes the treatment evolved by Godoy Moreira.

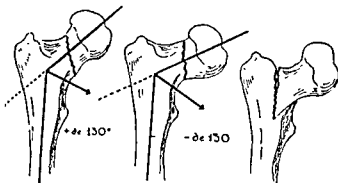


Fig. 1. At left are seen the two varieties of medial fractures of the femoral neck: In valgus, with the angle greater than 130 degrees; in varus, with an angle less than 130 degrees. On the right is seen the lateral type.

The author presents a general description of the anatomy, development, architectural features, and lines of stress associated with fractures of the neck of the femur.

Discussing the vascular supply of the upper portion of the femur, the author quotes the work of Zarzaga. He concludes that the blood supply to the hip joint and upper portion of the femur is maintained by an anastomosing arterial plexus derived ultimately from the profunda femoris and the internal iliac arteries. This includes branches direct to the bone, as well as the artery of the round ligament.

Fractures of the upper femur are discussed in the light of their classification by several methods. The author prefers to classify fractures of the neck as medial and lateral. The medial fractures may be in valgus or varus (Fig. 1). The medial fractures are difficult to hold in reduction and, therefore, offer a more serious prognosis, particularly when in varus as they then require surgical fixation. Lateral fractures are much easier to maintain in reduction and offer a better prognosis. Immobilization in plaster is frequently the treatment of choice.

Fractures of the femoral neck constitute approximately 40 per cent of femoral fractures and of these, according to the author's classification, the lateral type is the most frequent, and the medial type in varus is next in the proportion of 4 to 1. The medial type in valgus is relatively rare.

The mechanism of these fractures is discussed. The symptomatology is developed in some detail. The symptoms and signs common to all types of fractures of the femoral neck are dysfunction, attitude of the member, pain, deformity of the inguinal fold (Laugier's sign), shortening (8 measurements and methods of measurement are described), hydrarthrosis of the knee, ecchymosis, and edema of the base of the coccyx. The medial type of fracture, complete and not impacted, which is the usual type, completely prevents active motion and extreme external rotation; shortening is immediate, Laugier's sign is present, and the inguinal mass is well medial; spontaneous pain is not very marked, but pressure on the femoral head and passive motion are painful. When impacted, some active motion is usually pos-

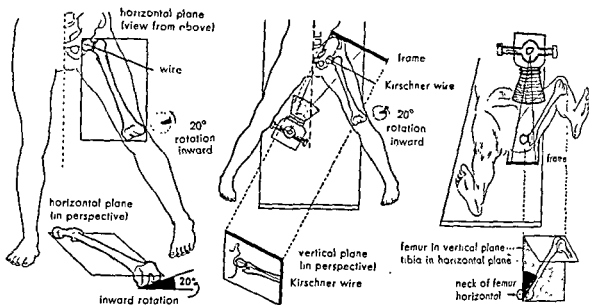


Fig. 2. Position of the patient, x-ray tube, cassette and projections of the femur; at left, A-P projection; center, the lateral projection; at right, the "lithotomy" position.

sible; Laugier's sign is not marked, nor is the shortening pronounced.

In the lateral type with impaction, which is the rule, movement is possible. The member is externally rotated; the thigh and knee are semiflexed and usually the thigh is adducted, although abduction is seen; shortening is pronounced; Laugier's sign is present and lateral in position; spontaneous pain is not great, but pressure over the greater trochanter and passive motion are very painful.

Prognostically considered, fractures of the femoral neck result in (1) bony union in anatomical position, (2) bony union in poor position, (3) bony union with or without accompanying arthritic changes, and (4) pseudarthrosis. The medial type of fracture, particularly in old persons, offers a poor outlook for a completely satisfactory result when managed by current methods. Lateral fractures, however, result in a satisfactory outcome consistently. A pseudarthrosis in this type is exceptional.

The complications occurring in patients with the lateral fracture include fat embolism, intra-articular suppuration, phlebitis, urinary retention, decubitus ulcers, and, finally, lung involvement.

The complete diagnosis of these lesions requires use of the x-rays. Not only are they required for accurate determination of the presence of fracture and its type, but also for control of the operative procedure. The x-ray views should include the anteroposterior, the lateral in position of reduction, and the lateral with the patient in the lithotomy position (Fig. 2).

The treatment of these fractures according to the author's classification can be summarized as follows:

1. Medial fractures in valgus are to be treated operatively in the aged and by simple extension in the young.

2. Medial fractures in varus are to be treated operatively regardless of age.

3. Lateral fractures are treated in plaster in the young and in the older patient who is in good general condition. In old patients in poor condition, operative intervention is indicated. (Children are not considered in this discussion).

An exhaustive description of the various methods of treatment and a summary of the results accompanied by illustrations are given. The methods discussed include that of Lucas Championniere; continuous extension; and immobilization in plaster, by bone graft, by osteotomy, by resection and ankylosis, and, finally, by metallic extra-articular fixation.

The method of Godoy Moreira, in summary, follows:

After the fracture is reduced under roentgenographic control, a 10 cm. incision down to the bone is made at the level of the greater trochanter. The muscle mass is separated in order to visualize the lower aspect of the trochanter (called the innominate tubercle) which serves as a guide for the procedure. At this point a small initial defect is made in the bone. The direction of the femoral head and neck is obtained by using the standard anatomical landmarks, aided by a metallic centimeter ruler placed over the anterior upper thigh in the presumed direction of the femoral neck. This ruler is included in the postreduction roentgenogram. A Kirschner wire is then introduced with an electric motor; however, it is finally driven to contact the cortex of the femoral head by the use of a hammer. An 11 mm drill is used to tunnel the greater trochanter in order to accommodate the locking shaft of the apparatus later. The tunnel through the neck is completed with a 6 mm. drill so as to receive the body of the

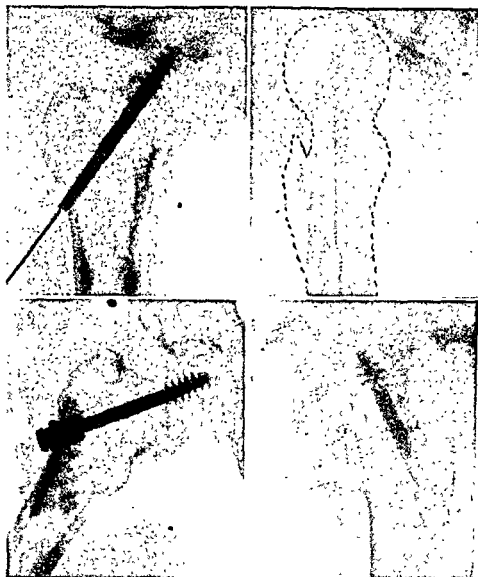


Fig. 3. Final roentgenographic control before and after the impaction.

screw. The drills and the screw are hollow and are threaded over the Kirschner wire as a guide. The fragments of the fracture are finally impacted with the locking shaft and counter screw. (The wire is removed after the introduction of the screw.) The fragments are held immobilized during the procedure by a special lever held by an assistant against counter pressure on the pelvis by still another assistant.

The author has introduced some modifications in the method, and the patients are managed along the following general lines:

The diagnosis of fracture having been made and surgical intervention having been decided upon, the patient is placed in light traction in extension, abduction, and internal rotation for a period of from 8 to 10 days. The Hawley-Scanlan orthopedic table is employed but modified by being divided into two longitudinal halves, presumably displaceable but no longer than sufficient to reach the patient's knees, so

that the x-ray tube may be brought up between the knees for taking the lateral roentgenogram. The pelvic support is made of wood. A means of rapid film development is used. General anesthesia is not employed.

The fracture is then reduced. With the anatomical landmarks as a guide, a Kirschner wire is introduced with an especially designed electric motor, for a distance of from 4 to 6 cm. only. Roentgenograms are then taken in anteroposterior and lateral projections to determine the adequacy of the reduction and the direction of the wire. If the direction of the wire is not satisfactory, another is similarly introduced with the necessary correction, without removal of the first. The proper screw is then selected, and the Kirschner wire is taken as a measure, since it is of known length (30 cm.). The area of the wire is then laid open by a small incision down to the bone. An 11 mm. drill is then used to tunnel the cortical bone for a distance of 2 cm. The screw is



## INTERNATIONAL ABSTRACTS OF SURGERY

then passed over the wire as a guide and set into the head of the femur without further preliminary drilling. The locking shaft and counter screw are then set, the fragment being impacted as desired. A roentgenographic check is made again. No immobilization is used postoperatively. Active and passive motion, as well as sitting, is begun promptly. Walking is delayed from 45 to 60 days.

Later experience suggests that a Kirschner wire can be fixed to the skin of the thigh in the proper direction of the head and neck, as determined by fluoroscopic control, and then the transfixing wire can be introduced, this wire being used as a guide in association with lateral fluoroscopic control. An additional wire is recommended even if it is demonstrated that the first is correctly placed, in order to prevent rotation or slipping of the fragments during the subsequent steps.

Twenty-four cases have been treated by this method and 6 others by means of the Smith-Petersen nail. Twenty-seven of the cases were medial pseudarthrosis of a year's duration. The patients ranged from 28 to 85 years of age. Twenty-one of the 30 cases resulted in excellent bony union; 3 developed pseudarthroses (these were considered poor results); 1 other case developed pseudarthrosis, but was classed as having a good result because the screw permitted walking. The results in 2 cases cannot as yet be evaluated (5 months). On patient died; 2 patients did not tolerate the screw, requiring its removal in 8 and 75 days, respectively. The latter patient eventually succumbed to cardiorenal disease. Associated diseases in these patients have often been serious.

HIRSH T. LANGSTON, M.D.

Hampton, O. P., Jr.: Delayed Internal Fixation of Compound Battle Fractures in the Mediterranean Theater of Operations. *Ann. Surg.*, 1946, 123: 1, 238.

This article, written in two parts, presents a follow-up study and evaluation of the treatment of 332 compound battle fractures treated in the Mediterranean theater of operations by delayed internal fixation. Plates, screws, and wire were the modalities of internal fixation employed. Part I describes the procedures, statistics, and conclusions. In Part II 20 case reports with illustrations are provided to demonstrate the problems involved.

The use of delayed internal fixation in the Mediterranean theater of operations began in April, 1944, and the great majority of the operations were performed between June 4, 1944 and November 1, 1944. The operations were performed in 18 base hospitals by approximately 50 surgeons. The information for this report was gathered by the author between March 16 and April 26, 1945 and represents a follow-up period of less than a year for the majority of the cases. Twenty-four Army general hospitals located throughout the United States were visited during this 6 weeks and 300 complete case reports were assembled. Thirty-two additional patients were

located as on duty, demobilized, or in convalescent hospitals, and this status was considered as reasonable assurance that the results were very satisfactory. Although not specifically stated, it is presumed that the report covers all the compound battle fractures treated by delayed internal fixation during the dates mentioned. No comparison is made in this article between the results in these cases and similar data for groups of battle fractures managed without the use of delayed metallic fixation.

Initial surgery as compared to reparative surgery is the excisional phase which is designed to save life and limb and prevent infection. It is performed in the combat zone as soon after wounding as is feasible. Reparative surgery is performed in a base hospital from 5 to 10 days after wounding and the routine procedure for compound fractures is as follows:

The operating room is set up for any possible indicated surgery on a compound fracture. The patient is properly prepared and is anesthetized in the operating room, where the encasement and dressing which had been applied after initial surgery are removed. The extremity is cleansed, prepared, and draped. The wound is visualized thoroughly by gentle traction. Any residual dead tissue is excised and the depths of the wound are cleansed of blood clot. The fracture site is exposed. It is there and then that internal fixation may be employed as part of the first procedure of reparative surgery if its advantages are obvious, e.g., in condylar fractures of the joints, oblique fractures of the long bones which are easily reducible, or segmental defects due to bone loss. Wound closure, usually with drainage, completes this stage of reparative surgery. In the great majority of cases, reduction is attempted by traction or manipulation. If adequate reduction is not achieved and the contour of the fracture permits internal fixation may be performed at another operation, perhaps after wound healing. Internal fixation was not reserved for the ideal case but was employed frequently in fractures that would be major problems under any plan of management.

The advantages of delayed rigid internal fixation in the management of a compound battle fracture are: (1) Optimal apposition and alignment; (2) elimination of the dead space of an unreduced fracture, and its attendant traumatizing manipulations; (3) early joint motion and muscle exercise may be permitted; (4) multiple operating room procedures for concurrent injuries are permitted; and (5) staged fixation in these injuries may be stated as follows: (1) any periosteal stripping incident to the open reduction and placement of the metal potentially devitalizes the denuded cortex of bone; (2) the extent to which the metal interferes with the reattachment of soft parts to denuded bone enhances the chances of sequestration; and (3) the trauma incident to the fixation, retractor pull or vessel ligation, may devitalize the soft tissue and thereby establish a nidus for wound sepsis.

The indications for delayed internal fixation were divided into three groups: obligate, desirable, and elective. The obligate group was again divided into 5 groups: (1) bone loss producing a segmental defect or persistent distraction, in either of which nonunion is almost inevitable; (2) inadequate reduction by nonfixation measures, skeletal traction, "hanging cast", or manipulation; (3) condylar fractures at the knee or elbow; (4) massive loss of soft tissue which demanded repeated staged procedures and preferably a fixed fracture; and (5) associated nerve trunk injuries, the optimum management of which required fracture fixation. The desirable indications varied with the bone involved and all fixations were performed at the first operation of reparative surgery as follows: the femur was rigidly stabilized with plates or screws in the nonobligate group; the tibia and fibula were rigidly stabilized with screws only in the nonobligate group; the radius and ulna were subjected to all types of fixations in the nonobligate group. No indications were classified as desirable among the fractures of the humerus. For the elective indications, all fixations were done at the first operation of reparative surgery. These included all wire loop fixations of the femur in the nonobligate group; all platings (including those of the fibula) and wire loops of the tibia and fibula in the nonobligate group; and all types of fixation of the humerus in the non-obligate group.

The results of delayed internal fixation were classified into 6 groups summarized as follows:

Result A. Union of the fracture and wound healing without sequestration or removal of the metal.

Result B. Union of the fracture, and, following removal of the sequestra and metal, wound healing.

Result Ba. The same as B but the sequestration was massive, so as to prejudice the strength of the bone.

Result C. Union of the fracture but no wound healing; however, in many cases the metal and sequestra were not removed.

Result D. Union of the fracture and wound healing after removal of the metal and sequestra, but the time required for each was prolonged appreciably.

Result E. Nonunion of the fracture but wound healing without sequestration or removal of the metal.

Result F. Nonunion and sequestration without wound healing (in 5 cases the wounds healed after removal of the sequestra and metal).

Detailed statistical tables of data are compiled to show: (1) results in relation to the type of fixation, (2) results in relation to the indications, and (3) a summary of all results: (a) those not classed as excellent and (b) those not very satisfactory.

Each of the 25 cases with the F type of results is abstracted and an appraisal of them is offered by the author: (1) improvement following fixation, 2 cases; (2) no improvement, but healing not retarded, 8 cases; (3) healing retarded, 13 cases (3.9% of 332 cases); and (4) not classifiable at this time, 2 cases. An example of the complications in the F group is

quoted from the abstracted tibia and fibula cases—"Cases 4-9 (Four electives and two obligates—one for bone loss, one for faulty reduction). All were plate fixations. The sequestration was massive, wound healing was not achieved and the resultant scar will be excessive. These are failures in every sense and the surgery contributed directly to the prolonged disability. Bridging bone grafts will be necessary in several." The following conclusions are drawn:

1. There is a definite place for the use of delayed internal fixation in battle fractures in the fixed installations of the communications zone.

2. Its use should be as an adjunct to fracture management under the principles previously expounded for reparative surgery of compound fractures.

3. The results achieved in this group of cases are deemed very satisfactory with the exception of those in the plated fractures of the tibia and fibula and those associated with massive soft-tissue loss (obligate-4), particularly when they are evaluated in the light of their adjudged indications.

4. In the light of the results achieved in this series it seems reasonable to state that by the use of delayed internal fixation:

a. Nonunion of fractures with segmental defects or persistent distraction may be prevented in many cases, as is evidenced by the achievement of bony union in 27 (69%) of 39 cases in this series.

b. Varying degrees of malunion or, perhaps in some cases, delayed or nonunion of fractures, for which inadequate reduction was achieved by other measures, may be prevented in many cases, as is evidenced by the achievement of bony union in good apposition and alignment in 64 (85%) of 75 cases in this series.

c. Bony union in the optimal reduction of condylar fractures about the knee and elbow may be achieved, as is evidenced in 100 per cent of 15 cases in this series.

d. The obvious advantages of well stabilized maximum reduction of fractures which lend themselves to rigid stabilization and satisfactory wound healing may be achieved in many cases, provided the fixation is performed by multiple screws with minimal periosteal stripping, as is evidenced by union in good position in 94 (98%), and wound healing without sequestration or the removal of metal in 71 (74.7%) and in another 14 (14.9%) after the removal of sequestra and metal in a total of 95 cases. If plating is the method of fixation, bony union and satisfactory wound healing may be anticipated in a smaller percentage of cases, as is evidenced by union in 140 (84.3%) and wound healing without sequestration or removal of metal in 99 (59%), and readily in another 34 (20.3%) after removal of sequestra and metal in a total of 168 cases.

e. Improved apposition of the fragments may sometimes be accomplished with the aid of

wire loops, as is evidenced by the achievement of bony union in 59 (85.5%) and of wound healing without sequestration or removal of metal in 50 (72.5%), and in another 12 (17.4%) after removal of sequestra and metal in a total of 69 cases regardless of any other qualifying factors.

5. The hazard of delayed internal fixation appears to be increased sequestration, which may be explained by the periosteal stripping which the procedure entails. Sequestration occurred in 34.3 per cent of the cases in this series and it seems reasonable to state that with:

a. Screw or wire fixation, sequestration is seldom massive, does not seem to interfere with union of the fracture, and probably would have occurred in many cases had nonfixation measures been employed.

b. Plating, followed by sequestration in 41 per cent of 168 cases, is sometimes followed by massive sequestration and retardation of the attainment of full strength of the bone. It may create a massive defect reparable only by bone grafting.

6. Unless the fracture contour permits a rigid fixation by screws or unless wire loops appear advantageous, it is preferable to attempt reduction by traction or manipulation and strive for early wound healing.

a. Following wound healing, fixation by plating or other fixation is relatively nonhazardous, as is evidenced by wound healing in 95 per cent of 21 cases in this series without sequestration or removal of metal.

b. Fixations of the long bones of the upper extremity may be expected to give excellent results if the severity of bone loss or of the soft tissue injury does not prejudice the chances of union and wound healing.

c. Fixations of the femur performed on indications, with multiple screws or wire loops and with minimal periosteal stripping, may be expected to give excellent results.

d. Fixations of the tibia by multiple screws or wire loops may be expected to give very satisfactory results. Plating of the tibia should be reserved until after wound healing. In the cases of tibia fracture, 8 of the 9 failures and 6

of the 8 massive sequestrations followed plate fixation.

e. The plating of the fibula in a fracture of both bones may be a useful procedure which is relatively nonhazardous. It maintains length and alignment, aids in achieving apposition of the tibial fragments, and provides some degree of immobilization of the fracture of the tibia.

7. Internal fixation as an adjuvant to the management of the unreduced septic compound battle fracture may aid in the control of sepsis and in achieving the best obtainable result. Among 29 cases in this series bony union was achieved in good alignment in 20 (69%), wound healing without further sequestration in 13 (45.5%) and after removal of sequestra and metal in 13 (17.5%) additional.

8. The indications for delayed internal fixation can be defined only for those instances in the management of the wounded in which the advantages offered by maximum fracture reduction and (usually) stabilization would not be overshadowed by other considerations. With this qualification it may be stated that the indications for the use of delayed internal fixation in the base hospital either at the initial operation of reparative surgery or later are:

a. Obligate

(1) Segmental defects or persistent distraction of fragments

(2) Inadequate reduction by other measures

(3) Displaced condylar fractures

(4) Associated nerve surgery which can be facilitated greatly by fixation

b. Desirable (advantageous)

(1) Fractures of the long bones (especially the femur) the contour of which permits rigid stabilization by multiple screws with minimal periosteal stripping

(2) Fractures in which nonrigid fixation by wire loops will provide a degree of fracture reduction probably not attainable without it

9. Further study of this problem and a comparable study of fractures managed by nonfixation measures are definitely indicated. Each case should be evaluated in the light of the problem confronting the overseas surgeon and the anticipated result by fixation and nonfixation measures.

CHARLES A. WALTHAM, M.D.

# SURGERY OF THE BLOOD AND LYMPH SYSTEMS

## BLOOD VESSELS

Rose, C. A., Hess, O. W., and Welch, G. S.: *Vascular Injuries of the Extremities in Battle Casualties. Ann. Surg.*, 1946, 123: 161.

This article is based on experiences in the management of 100 consecutive patients with arterial injuries of the extremities encountered in an evacuation hospital in the European campaign. Only major arteries were considered.

The diagnosis of arterial injury in the extremities was not difficult in most cases, i.e., when a cold pulseless limb was observed unilaterally. However, in two types of cases the diagnosis was less obvious. Badly shocked patients with no palpable peripheral pulses in any extremity had to be re-examined frequently for evidence of arterial injury as their condition improved. In addition, it was possible to have palpable distal pulsations in cases with small lacerations of the arteries. A firm hematoma in the region of a small wound was particularly suggestive of arterial laceration since venous bleeding rarely caused arterial compression even in such a closed space as the popliteal fossa. It was rare to find the classical signs of arterial aneurysm or arteriovenous fistula early after injury.

Plasma was used preoperatively in treating patients in whom there had been little loss of blood, but many of these patients had lost upward of 2 liters of blood and shock was frequently severe. Blood transfusions of from 500 c.c. to 3,000 c.c. were given to 55 of the 100 patients. There was practically never active bleeding at the time of admission but during treatment for shock, the rise in blood pressure was sometimes followed by recurrence of the hemorrhage. If the bleeding vessel could not be visualized and controlled quickly, a blood pressure cuff was applied as a tourniquet. Oxygen, and sulfadiazine, by mouth, and penicillin intramuscularly were all started preoperatively and continued as long as indicated.

Careful débridement was performed through the extended existing wound, but care was used to avoid damage to all vascular radicles which could provide collateral circulation. Nine patients required primary amputation because of extensive wounds more than 16 hours old which were complicated by compound fractures and severed arteries with extensive distal thrombosis. In 5 cases, arteriorrhaphy was performed. The arterial wounds were small and easily repaired in each instance, and none of the wounds were associated with extensive tissue damage. Ligation of the injured artery was done in 70 cases. Thrombosed or damaged segments were excised and the companion veins were similarly ligated and severed. Eight patients were subjected to arterial anastomosis performed by the nonsuture technique of Blakemore and Lord. One patient died at opera-

tion from a pulmonary embolism; 5 patients developed gangrene afterward; 2 operations were followed by a viable extremity. The authors believe that in both of the latter cases the collateral circulation was good enough to have saved the extremity without arterial anastomosis. Heparin was used in only 2 cases and in both of these gangrene developed. The poor results of the Blakemore method are attributed to the lack of patency of the arterial system distal to the anastomosis, even though the procedure was limited to patients treated within 14 hours of the time of injury. Eight patients were treated conservatively, i.e., by débridement only. In 2 of these, gas gangrene developed and amputation became necessary. The other 6 recovered with viable extremities. The results are given in the following table.

Treatment	Results	
	Good	Poor
Primary amputation. . . . .	0	0
Arteriorrhaphy . . . . .	5	0
Ligation . . . . .	33	37
Nonsuture anastomosis . . . . .	2	6
Débridement only. . . . .	6	2

Postoperative treatment included the use of alcohol and papaverine for vasodilation and of sympathetic blocks with 2 per cent procaine. Refrigeration was attempted in only a few cases. Only 2 lumbar sympathectomies were done. Because of the damage to the collateral vessels which was frequently present, the effect of these various procedures was not striking. Despite the routine use of sulfadiazine and penicillin, gas gangrene developed in 12 patients, of whom 11 were subjected to amputation. Three died of the infection. There were 3 other deaths from crush syndrome, pulmonary embolism, and a severe hemolytic blood transfusion reaction, respectively.

An analysis of the results showed the factors which determined the prognosis for survival of an extremity with injury to a major artery. The time factor seemed important inasmuch as two-thirds of the limbs survived when surgery was performed within 10 hours of wounding, whereas less than one-fourth survived after 20 hours. As was expected, the prognosis was better when the degree of arterial injury was not severe. The influence of the degree of tissue damage was striking. The survival rate of the limbs with slight tissue damage was 85 per cent but only 21 per cent of those with severe tissue damage were saved. The effect of the anatomic location of the arterial wound was consistent with acknowledged principles; namely, that the prognosis for interruption of the major vessels was better in the upper extremity than in the lower extremity, and injuries that involved major collateral vessels resulted most often in gangrene.

THEODORE B. MASSELL, M.D.

**Pratt, G. H.: The Surgical Management of Arterial Occlusion.** *J. Am. M. Ass.*, 1946, 130: 827.

The author outlines his methods of treatment in various conditions presenting acute arterial occlusion. Traumatic laceration of an artery is repaired by a continuous fine silk stitch which does not pass through the intima. The suture line should be reinforced by wrapping a strip of fascia or muscle around the site of repair. Treatment after arterial suture includes the use of anticoagulants, sympathetic nerve blocks, and the administration of vasodilator drugs.

Incomplete laceration of a major artery may result in a false aneurysm. For arterial aneurysm the sac is obliterated but not excised, in order not to injure the collateral vessels which run in or near the sac wall. When contusion causes local thrombosis the author advocates opening of the artery and removal of the thrombus.

Embolism of a major peripheral vessel usually occurs at a point of bifurcation. While embolectomy should be done within 24 hours, the author reports success following removal of an embolus of the bifurcation of the aorta 60 hours old. An approach just below the inguinal ligament is advised. After the clots are removed the artery is washed with heparin.

Postoperative treatment includes the use of anticoagulants and sympathetic nerve blocks.

Acute occlusion may be caused by infection with the streptococcus or the gas producing group of clostridia. The presence of crepitation in the tissues does not alone constitute an indication for amputation. The diagnosis of a gas bacillus infection should be made on the clinical picture: fever, a high pulse rate, sanguineous drainage from the wound, massive edema, and the anxious sick look of the patient.

Scalenus anticus syndrome may cause thrombosis of the subclavian artery. After scalenotomy the author advises sympathetic blocks or a preganglionic thoracic sympathectomy.

THEODORE B. MASSELL, M.D.

**Dandy, W. E.: Results following Bands and Ligatures on the Human Internal Carotid Artery.** *Ann. Surg.*, 1946, 123: 384.

In the surgical treatment of intracranial aneurysms it is at times necessary to occlude the internal carotid artery partially as a preliminary step before totally closing the artery. A partial ligation is necessary when the Matas test indicates an inadequate collateral circulation at the circle of Willis. In a group of 6 patients in whom a band of fascia lata had been placed for this purpose and in whom total ligation became necessary later, the segment of the artery, including the band, was excised at the second operation after intervals varying between 16 and 58 days. The specimens were subjected to gross and microscopic study principally to learn what happens to the affected portions of the artery and to the band. In addition, specimens following total ligation of the internal carotid (1 case), total ligation of the com-

mon carotid (1 case), and ligation of the intracranial carotid by a silver clip (1 case) were studied.

In the 6 specimens following partial occlusion of the internal carotid artery by fascial bands, the lumen of the artery remained patent, although greatly reduced in size. In only 1 case was there any indication of a thrombus within the lumen; in this case the thrombus was a tiny nonobstructing carunclelike fibrous nodule. In all cases there was an excessive bulbous mass of fibrous tissue about the bands. The size of the swelling increased with time, and at the end of 58 days was about four or five times larger than the original volume of the fascial band. The bands showed marked fragmentation in all specimens and could be delineated only with difficulty or not at all in the older specimens. A rather surprising histological finding was the absence of any reaction throughout the intima of the arteries, there being no tendency toward vascular rupture.

In the 2 cases, following total ligation of the carotids, there was extensive thrombus formation within the lumens, and it was clear from these cases that the extent of intra-arterial thrombosis resulting from total ligation is variable and unpredictable and is not, as has been frequently stated, limited by the first sizable branch (the external carotid).

The single specimen taken 19 days following application of a silver clip to the internal carotid is included in this report because there was no thrombus on either side of the clip. This was observed on at least 4 other occasions when the site of the clip was subsequently exposed at a second operation. That a thrombus is consistently absent after the application of a silver clip cannot be stated without many more observations. However, in a series of 38 intracranial "clippings" of the internal carotid there has never been any clinical evidence of cerebral thrombosis. These findings indicate a disadvantage in the use of a clip when thrombus formation is desired to cure an aneurysm.

It is very probable, but not certain, that a thrombus always develops in time on either side of a ligation on a large arterial trunk. Doubtless this is due to injury of the intima, which must always occur. And yet, bands of fascia and aluminum, whether partially or totally occluding, appear not to do this. The development of a thrombus after ligation and its absence following application of a band, are the reasons for need of a better form of ligation of the internal carotid. When a clot forms in the carotid it may break off and send an embolus into the cerebral arteries with disastrous results; or the clot may propagate from the site of the ligation and pass directly into the cerebral vessels with the same result. Either of these eventualities is the explanation for the hemiplegias and deaths that occur from 12 to 66 hours after carotid ligations. The author is certain that they can be avoided either by means of totally occluding bands of fascia or by ligation over a band of fascia. The ligation does not then cut the intima. The latter procedure is probably preferable and more certain.

JOHN L. LINQVIST, M.D.

Loewe, L., Rosenblatt, P., and Illrsch, E.: Thromboembolic Disease. *J. Am. M. Ass.*, 1946, 130: 386.

The treatment of venous thromboembolic disease with the subcutaneous administration of heparin in the Pitkin menstruum was attended with lessened morbidity, prompt and rapid clinical improvement, and little or no residual edema.

After failures of treatment with other methods recovery has subsequently followed the routine administration of heparin in the Pitkin menstruum.

As a result of observations of its clinical results in 125 consecutive cases of thrombophlebitis and/or phlebothrombosis, the subcutaneous administration of heparin in the Pitkin menstruum is recommended as a safe, simple, practical, and effective method for the conservative treatment of venous thromboembolic disease.

Eleven cases are reported.

JOHN J. MALONEY, M.D.

### BLOOD; TRANSFUSION

Lewis, J. H., Tagnon, H. J., Davidson, C. S., and Minot, G. R.: The Relation of Certain Fractions of the Plasma Globulins to the Coagulation Defect in Hemophilia. *Blood, J. Hemat.*, 1946, 1: 166.

The authors state there is evidence that by the parenteral administration of derivatives of normal cell-free plasma in hemophilia, the coagulation defect can be modified toward normal. They present a brief history of older work on this subject, and new evidence accumulated during the past 3 years. Competent investigators have shown that the coagulation defect in hemophilic blood could not be related to deficiency in the calcium ion, prothrombin, or fibrinogen of the plasma. Consequently, the investigations were directed toward an attempt to determine where the deficiency, if any, resided. It was determined that certain globulin fractions prepared by acid precipitates of diluted cell-free plasma at pH 5.5, and also similar globulin preparations obtained by simple dialysis against distilled or tap water, contained all the antihemophilic properties of the parent plasma.

It would appear that the antihemophilic properties of these globulin preparations were not due to the removal of inhibitory materials, since the parent plasmas were active and the supernatant fluids from the globulin precipitants had no inhibitory activity and only minimal coagulation activity. Furthermore, hemophilic plasma treated by the same method did not acquire any increase in antihemophilic properties. The exact nature of the antihemophilic material is not known. It is definitely associated with the plasma globulins, but whether or not it is a lipoprotein has yet to be determined. Howell termed the material "plasma thromboplastin," but evidence is lacking as to whether or not this nomenclature is acceptable.

As part of the blood substitutes program conducted during the war, large quantities of human

plasma have been subjected to multiple fractionation by E. J. Cohn and workers in the Department of Physical Chemistry at the Harvard University Medical School, Boston. Various subfractions of the globulin group have been extensively tested for antihemophilic activity in the Thorndike Memorial Laboratory and extensive studies on the antihemophilic properties of fraction I are being carried out on adult patients in the Boston City Hospital. A discussion of these studies is presented.

Of equal importance with the shortening of the coagulation time of the circulating blood in hemophilia is the local control of hemorrhage when this occurs. The antihemophilic globulin substance acts as a local hemostatic when applied in dry form with adequate dressings to the bleeding point. Antihemophilic globulin preparations act, apparently, through the normal coagulation reaction and depend for their activity on the release of thrombin from prothrombin; hence an instantaneous arrest of hemorrhage does not occur.

Another globulin preparation may be obtained from human, bovine, rabbit, or swine plasma by a salting-out procedure. Investigators found that these pseudoglobulin preparations were thrombic in nature; they acted directly on fibrinogen without the intervention of calcium ion or prothrombin.

Hemostatic globulin is definitely superior to the antihemophilic globulin in the control of hemorrhage, since its action is immediate. In persons with hemophilia, it has been used to control bleeding following amputation, debridements, and dental extractions. In normal persons also it has been widely used, a notable example being its employment as a physiologic glue in skin grafting.

The question of possible toxic reactions to animal globulin preparation applied locally immediately arises. It may be reported that in using a rabbit hemostatic globulin, no untoward local effects or systemic reactions were observed following many multiple local applications of the substance in the control of hemorrhage in hemophilic and normal subjects.

In conclusion, the authors note that hemophilic blood appears to be deficient in some activity associated with the globulin fraction of the plasma protein. The chemical identity of the missing factor or factors is not at present known. However, it should be remembered that until final proof is obtained, both of these terms imply an association rather than identification of the antihemophilic activity with the plasma globulins.

Normal cell-free plasma and the antihemophilic globulin preparations derived therefrom will, on treatment with chloroform, give rise to a proteolytic enzyme system having some as yet undefined role in blood coagulation. In fractionations of human globulins, such spontaneous production of lytic agents has been found in subfraction II of fraction III, and occasionally in fraction I.

Hemophilic plasma does not produce such proteolytic enzyme systems in optimal amounts. Whether

this is due to the lowered amount of the precursor, or to the presence of inhibitor materials, is at present unknown.

The intravenous injection of antihemophilic globulin results in a marked acceleration of the clotting time of hemophilic blood. So far only fraction I of the plasma globulin has been used clinically. The dose of the material has not yet been determined, but single injections of 200 to 400 mgm. of the material will keep the blood of a hemophilic patient at low coagulation levels for from 8 to 12 hours.

For local hemostasis, a pseudoglobulin may be prepared from human, bovine, swine or rabbit plasma by a salting-out procedure. Thrombin from rabbit plasma has been used without untoward local or systemic reactions in amputations, débridements, and dental extractions in hemophilic patients.

HERBERT F. THURSTON, M.D.

Rainsford, S. G., and Morgan, W. T. J.: Determination of Blood Groups: Use of Rabbit Immune Serum. *Lancet*, Lond., 1946, 1: 154.

A method of rapid blood typing which would allow the accurate selection of men with group O blood for emergency transfusion was needed by the Royal Navy. It was believed that this selection would be made easier if a reagent could be supplied which would contain both anti-A and anti-B agglutinins. The difficulty of supplying such a reagent by mixing anti-A and anti-B serum from human sources was due not only to the reduction of isoagglutinin titer by simple dilution, but also to the fact that in most human sera there was some agglutininogen corresponding to that present in the cells of the blood from which the serum was obtained. The agglutinogens neutralize the homologous isoagglutinins and thus further reduce the anti-A and the anti-B titer of the reagent. These difficulties were to some extent obviated if the serum from an O blood were used; but it was found that although sera from O donors often showed higher anti-A and anti-B titers than were found in the sera of A and B bloods, they were not in most instances sufficiently potent to be suitable for use as blood grouping reagents.

Previous work by one of the authors (Morgan) on the production and properties of potent anti-A agglutinins in rabbits suggested that, if a similar serum specific for the detection of B-erythrocytes could be produced, a mixed immune rabbit serum containing these two agglutinins might be a reliable blood grouping reagent for the rapid detection of group O donors. One advantage which rabbit serum had over human serum was that at the dilution used the former was a clear colorless reagent whereas the latter was usually colored. This color rendered the rapid reading of the reactions without the aid of a microscope less definite.

Rabbits were immunized with an artificial antigenic complex made from purified human A substance. The serum was then pooled and absorbed so that the following titer was obtained for cells of different phenotype: A<sub>1</sub> and A<sub>2</sub>, 20,000; A<sub>2</sub>B,

10,000; B, 16; O, nil. To test the specificity of the rabbit anti-A serum, it was titrated in parallel with the human anti-A serum. The human serum was used at a dilution of 1:4 and the rabbit serum at a dilution of 1:200. There was complete qualitative agreement between the results obtained with the human and rabbit sera. The rapidity of the agglutinations was, however, greater with the rabbit serum than with the human anti-A serum. In the method of testing used, this greater avidity of rabbit serum for the cells was considered an important factor since the contact between the antigen and the antibody was necessarily limited because of the rapid and significant evaporation that took place from the large surface area of the mixed cell suspension and agglutinin solution.

During the early part of the investigation, and before a suitable anti-B rabbit immune serum had been produced, a mixed reagent was prepared from anti-A rabbit serum and human anti-B agglutinin. This mixed serum agglutinated all types of cells other than O within 5 minutes. The accuracy of tile agglutinations with the mixed serum was tested in a series of several thousand determinations by subsequent test tube agglutinations of the same bloods. The percentage error varied from 0.63 to 0.85 per cent. When human anti-A and human anti-B sera were used separately, the percentage error was 2.4 per cent.

For preparation of rabbit anti-B serum, the specific blood group B substance was obtained from pseudomucinous ovarian cysts. It was converted into a full antigen by combination with the conjugated protein component of the O somatic antigen of bacillus shigae by the method already described for the preparation of an artificial A antigen by Morgan. Rabbits were given serial doses of the artificial complex and were bled from 7 to 9 days after the last dose. The titer for B cells of one preparation of anti-B serum after absorption with A and O cells was 5,000; the preparation did not react against A cells at a dilution greater than 1:8. Bloods to the number of 1,093 were tested in duplicate by the tube method with the rabbit anti-B serum at a dilution of 1:25 and a human anti-B serum at a dilution of 1:4. There was complete agreement between the results obtained by the two sera, but more complete reactions were recorded with the rabbit serum. In tile agglutinations the rabbit anti-B serum was more reactive and showed greater avidity than the human anti-B agglutinin.

The accuracy of 961 rapid tile agglutinations with the mixed rabbit serum was checked by tube technique in the laboratory. The percentage of error was only 0.31 per cent. The authors conclude that the use of mixed anti-A and anti-B rabbit immune sera of high titer and avidity reduces the errors of blood grouping when O donors are to be selected rapidly from a group of untyped persons, and thus the mixed serum should prove of value in making the selection of blood for immediate transfusion more reliable.

THEODORE B. MASSELL, M.D.

Walsh, R. J.: A Report on the Transfusion of 2,386 Liters of Blood. *Med. J. Australia*, 1945, 2: 486.

The author presents an analysis of the use of 2,386 liters of blood. The reactions which occurred are discussed and the indications for transfusion are listed. Hemorrhage was the principal indication, and hematemeses was its most common manifestation.

Relatively there was a greater frequency of transfusions in obstetric practice. Two hundred and fourteen liters were used postpartum and 189 liters after abortion. Thirty eight liters were used in the treatment of ruptured ectopic gestations. Four hundred and sixty liters were used in the treatment of anemias and other blood dyscrasias. Two hundred and thirty-nine liters of blood were administered to patients suffering from carcinoma.

The author notes that the contention that group O blood is dangerous for transfusion to patients of other blood groups was not substantiated by his analysis. The alleged dangers of such a practice are examined in the light of recent knowledge and are herein discussed. Seventy-six per cent of the total amount of blood supplied was of group O. It is obvious, therefore, that group O blood was used for a large number of patients whose blood belonged to groups other than group O, inasmuch as only 49 per cent of the population have group O.

The Rh factor was found to be an infrequent cause of transfusion reactions. It is commonly stated that the most severe reactions are encountered in some of the blood dyscrasias. The data presented does not support this statement. Undoubtedly the most serious transfusion reactions are the hemolytic and the anaphylactic types. Hemolytic reactions with jaundice occurred in 4 cases. In 2, the Rh factor was found to be responsible. Two anaphylactic or anaphylactoid reactions were reported. One patient who had suffered from pernicious anemia for many years frequently neglected his treatment and reported on numerous occasions with very low red cell counts. For this reason he had received many transfusions over a period of 5 years. On this particular occasion, after the transfusion of 200 cubic centimeters of compatible blood, he suffered from an acute circulatory collapse with all the signs of an anaphylactic reaction. He gave sensitivity reactions to intradermal injections of the serum of one of the donors.

The danger of rapid transfusions to persons with a normal blood volume is stressed. Warnings for the slow administration of blood to patients with a normal blood volume have long been made by many writers, and the consequent dangers of circulatory overloading have been emphasized. There is usually little danger of circulatory overloading from the rapid administration of blood or serum to patients whose circulatory blood volume has been reduced; blood cannot be administered too slowly to patients suffering from blood dyscrasias, especially if myocardial weakness is present. Lack of consideration of this factor may be partly responsible for the impression that reactions are both frequent and serious in certain blood dyscrasias.

No evidence was obtained which would indicate that certain diseases render recipients susceptible to transfusion reactions. Sensitivity and pyrogenic reactions are discussed. The subject of pyrogens is complex. The author notes that such substances are a frequent cause of transfusion reactions, as was well shown by the experiences reported at Mount Sinai Hospital. This hospital reduced the incidence of transfusion reactions from 23 per cent to less than 13 per cent by close attention to the technique of cleansing and sterilizing apparatus. Great care to avoid pyrogens is exercised in the preparations of solutions, flasks, and other apparatus. Hospitals that pay attention to these details have a low reaction rate. The control of pyrogenic reactions rests to a large extent with the hospital or medical practitioner administering the blood.

Numerous factors cause blood transfusion reactions and are briefly mentioned. Reactions due to impurities in the solutions are minimized by the use of good quality chemicals. Clot formation in collected blood will render it toxic, just as defibrinated blood was found too toxic for general use. Small clots in a flask of blood are difficult to detect, but they are often responsible for reactions. The use of a blood filter will not remove their noxious influence. Hematoma formation due to difficulty in venepuncture either in the donor or in the recipient may be responsible for pyrexial reactions. Finally, undue venous congestion in the arm or leg of the recipient, caused by prolonged application of a tourniquet, may result in venous stagnation, with adverse effects on the recipient. In normal persons venous tourniquets may cause fainting and nausea if applied for too long a period.

HERBERT F. THURSTON, M.D.

Grossman, C. M., and Seward, E. W.: Homologous Serum Jaundice following the Administration of Commercial Pooled Plasma. *N. England J. M.*, 1946, 234: 181.

The authors report 8 cases of hepatitis with jaundice following the use of commercial pooled plasma, one of which proved fatal.

These patients had incubation periods ranging from 54 to 139 days, which is in conformity with the incubation period of the experimentally induced disease. Only one of the patients was seriously ill. The autopsy findings in this case differed in no way from those in cases ending in death following hepatitis due to the administration of yellow fever vaccine, nor are the findings different from those in deaths from infectious hepatitis.

In the two-year period during which these cases were observed, 501 transfusions of commercial pooled plasma were administered. The plasma was purchased from a commercial manufacturer with nationwide distribution facilities, who states that each pool consists of at least 50 samples. The occurrence of 8 cases of hepatitis with jaundice gives an incidence of 2 per cent, but this represents a minimal rather than a true incidence, since many patients received more than one transfusion of plasma, and



patients who developed hepatitis and were treated as outpatients, or by physicians elsewhere, did not come to the authors' attention. Furthermore, patients who did not develop clinical jaundice but nevertheless had the clinical features of acute hepatitis, such as nausea, vomiting, anorexia, and malaise, were not included.

The true incidence of this condition is not known at the present time. Reports in the literature vary from as many as 26 of 47 cases receiving pooled serum to 10,000 transfusions of pooled plasma without any recorded evidence of homologous serum jaundice, although in the latter report the authors state that their method may not have supplied complete data. The reasons for this discrepancy are manifold.

Since there is a relatively high incidence of infectious hepatitis at the present time, it is only natural to attribute any example of this clinical picture to spontaneously occurring agents. The long incubation period of homologous serum jaundice separates the disease from the etiological event by such a long period that causal relation may be overlooked. Finally, many physicians may not be alert to this possibility because of the absence of

information about this condition in the literature until the last few years. The incidence of this disease is undoubtedly becoming greater because of the increased use of commercially pooled plasma in cases in which transfusion of whole blood from a single donor was formerly used. The authors' experience confirmed this, since nearly 1,000 whole blood transfusions were given in the same two-year period with no case of manifest jaundice. The chance of the etiological agent's being given in any blood plasma therapy is many times increased as pools of 50 or more donors are mixed. The amount of icterogenic plasma necessary to contaminate a pool is minimal, since the disease can be transmitted by as little as 0.1 cubic centimeter.

In view of the disability, and the chance of fatality in homologous serum jaundice, the use of pooled plasma is not without danger. The fact that the icterogenic agent is not destroyed by drying and prolonged storage makes the tracing of the icterogenic sample difficult. Since it has been reported that the agent is destroyed by ultraviolet radiation, perhaps the hazard from the use of pooled plasma could be obviated by such a method.

CHARLES BAXON, M.D.

# SURGICAL TECHNIQUE

## OPERATIVE SURGERY AND TECHNIQUE; POSTOPERATIVE TREATMENT

Lam, C. R., and Hooker, D. H.: Pulmonary Embolism. *Ann. Surg.*, 1946, 123: 221.

The present review on pulmonary embolism is based on 118,611 operations performed during a twenty-one year period (1924-1944) at the Henry Ford Hospital, Detroit, Michigan. Of 280 cases of pulmonary emboli, 78 were fatal, an incidence of 1 fatality in every 1,500 patients operated upon. In 70 per cent of the fatal cases, the diagnosis was established at autopsy.

The authors point out that in the year of 1930, before the days of heparin, dicumarol, femoral vein ligation, and early ambulation, there was not a single case of fatal pulmonary embolus, while in 1943, when all of these preventive measures were available, there were 8 fatalities, although none of the 8 patients was given any specific prophylactic treatment.

All cases, fatal and nonfatal, are tabulated as to sex, age, type of surgery, and day of occurrence. Pulmonary embolism was more common in men than in women, the ratio being 3 to 2. Age increases the incidence of this complication, especially in the fifth decade, and fatalities occurred most often in the sixties.

The complication occurred most frequently following abdominal procedures. Gastric operations and prostatectomies were the worst offenders and showed an incidence of about 1 in 100 for fatalities; cholecystectomy showed an incidence of 1 in 500; hysterectomy, 1 in 600; hernia and appendectomy, 1 in 1,300.

Two peaks of fatal embolism were noted; namely, the sixth and eleventh days. This would correspond to the time of getting the patients up to go home at the end of 1 or 2 weeks, respectively. The authors believe that early ambulation may change this figure.

The clinical symptoms and signs are chest pain, more common in the right side—the ratio of pain on the right side to that on the left being 5 to 3. Hemoptysis, physical findings, and roentgenographic signs were each present in about half the cases. A friction rub was present in a third of the cases, and an effusion was demonstrated roentgenologically or by thoracentesis in a fifth of the cases.

One-half of the patients died in 10 minutes; three-fourths died in less than one-half hour, and 10 per cent of the patients lived for more than an hour, so that theoretically it would have been possible to operate upon a fourth of the patients, provided the circumstances were ideal.

The use of heparin and dicumarol is considered. Should these substances be given as a preventive to such large numbers of patients and, if so, what about the hemorrhagic complications? The authors believe that watching for local signs of thrombosis in the

legs, and the early performance of femoral vein ligation may be of value. Vein ligation was carried out in many of their cases, but these cases were not included in the present series because they had no emboli. The authors believe that early ambulation offers the most promise as a preventive measure.

BYFORD F. HESKETT, M.D.

## ANTISEPTIC SURGERY; TREATMENT OF WOUNDS AND INFECTIONS

Slaughter, W. B., and Wong, W.: The Early Management of Facial Injuries. *Surg. Clin. N. America*, 1946, 26: 2.

Since the early care of facial injuries is of great importance cosmetically, functionally, and psychologically, the excuse that other body injuries prevent adequate care is not excusable. With good clinical judgment, much can be done without endangering the patient's general condition.

Once clinical evaluation of the total body injury has been made, treatment instituted as indicated, and the immediate emergency is over, the facial injuries should be considered. A thorough physical examination of the face should be made. For ease and completeness a set routine should be followed.

The soft tissue injuries are usually readily apparent but should be noted carefully. It should be remembered that the swelling of these tissues may readily obscure the underlying bone defects.

Examination of the bony structures is best done bimanually, with gentle comparison of the two sides of the face. First the frontal area is examined, then the supraorbital ridges and the zygoma. The eyeball should be observed closely and an ophthalmologist called if necessary. The nasal bones are palpated for symmetry and to elicit motion or crepitus. The close association of the nasal bones with the maxillae, the frontal, lacrimal, and ethmoid bones, and the frequency of extensive associated fractures should be borne in mind. The nose should be examined intranasally for displacement of the cartilaginous portions. Examination of the maxillae should include palpation of the alveolar ridge and study of the occlusion of the teeth. Displacement of the orbital contents should be looked for. The mandible is examined in much the same way. X-ray studies are then made to confirm and localize whatever changes have been found.

Treatment may be immediate, delayed, or late in facial injuries. The immediate, which includes management of shock, control of hemorrhage, relief of pain, and splinting of parts, is the service which offers the patient maximum benefit, and the best possible treatment is therefore mandatory.

Primary suture is desirable and may be done within 4 hours in dirty wounds, and 6 hours in clean wounds. However, the adequate use of sulfonamides



avoid infection is imperative. Abscesses should be drained extraorally when indicated.

Alveolar process fractures occur in children and young adults. Any fragment with attachment to soft tissue should be saved. Fixation to adjacent teeth is necessary for stabilization.

After functional results are obtained, plastic procedures for cosmetic and psychological considerations may be considered. Lengthy operative procedures offering but slight improvement in the end should be avoided. In such cases, facial prosthetics should be considered. Wide disfiguring scars may be excised and replaced by a hairline scar if principles mentioned earlier in suturing are adhered to. Contracting scars causing ectropion of the eyelids and lips, and distortion of the nares may be corrected by the Z-plastic procedure. Full thickness grafts, pedicled grafts, cartilage, or bone may be considered in the late cosmetic correction of facial deformity.

EARL H. KLABUNDE, M.D.

Genes, S. G., Dinerstein, Z. M., Scheiferman, M. D., Baf, M. I., and Others: The Treatment of Wounds with Acidophil Paste and Acidophil Serum. *Vrachebnoe Delo*, 1945, p. 59.

The authors used acidophil serum and paste in the treatment of 27 patients with poorly granulating wounds caused by missiles or shrapnel, 10 with osteomyelitis, 34 with frostbites, and 1 patient with a burn. As a rule, the paste was applied daily. The treatment was supplemented by the administration of from 100 to 120 mgm. of ascorbic acid. Only such wounds with poor granulations were treated which did not show any improvement after the customary therapy with naphthalan, chloramine, potassium permanganate solution, cod liver oil, hypertonic saline solution, brilliant green, methylene blue, quartz lamp irradiation, blood transfusions, and skin transplantations. After the first 3 days of treatment with acidophil paste the necrotic tissue began to disappear and the number of pathogenic microorganisms, such as the streptococcus, staphylococcus and bacillus pyocyaneus, began to diminish. The odor subsided and gradually the granulation tissue became brighter. In the majority of cases the wounds healed in from 1 to 3 months although previous treatment with other methods continued for 12 or 15 months had failed. Failure was recorded in only 3 of 27 patients.

The results were less spectacular in frostbites if the treatment was instituted more than 6 months after necrotomy. However, if the treatment was instituted a few days after the necrotomy, extensive wounds healed in 1 or 2 months.

Osteomyelitis was treated with acidophil serum injected daily through the fistulous ducts. Considerable improvement or complete cure followed.

The treatment failed in 1 case of a burn, 5 cases of osteomyelitis, and 2 cases of slowly granulating wounds.

The burning sensation after the application of the paste usually disappears after the first 3 or 4 days of

treatment. Occasionally, small ulcers appear in the scar tissue, but they heal promptly. Sometimes the introduction of acidophil serum into a fistula is followed by a chill, rise in temperature, and malaise, but the symptoms disappear after 1 or 2 days. The beneficial effect of the treatment is attributed by the authors to the creation of an acid medium which interferes with the multiplication of the majority of the pathogenic microorganisms. Furthermore, lactic acid causes a vasodilatation in the wound, with a resulting hyperemia and intensification of the phagocytic properties of the leucocytes. The presence of casein in the paste contributes to the dessication of the wound, and the presence of fat prevents adhesion of the gauze to the tissues and softens the scar. Finally, there is the possibility of a local effect of vitamins A, D, and C on the wound.

The paste and the serum are prepared from lactic acid.

JOSEPH K. NARAT, M.D.

Palladin, A. V.: The Synthetic Production of Vitamin K and Its Use in Hemorrhages and the Treatment of Wounds. *Vrachebnoe Delo*, 1945, p. 9.

Vitamin K formed by plants, vitamin K<sub>1</sub> formed by bacteria, and synthetic vitamin K<sub>2</sub> (methyl-naphthoquinone) are usually employed in the presence of hypoprothrombinemia, e.g., for hemorrhages accompanying septicemia, peptic ulcer, and typhoid fever, and also for the hemorrhagic diathesis of infants.

Biochemical research by the author convinced him that synthetic vitamin K products are able to stop parenchymatous hemorrhages resulting from war injuries, surgical operations, or pathological conditions accompanied by vascular disturbances. Such synthetic products are effective no matter whether the amount of prothrombin in the blood is normal or diminished. The author studied 2 synthetic products, namely, methyl-naphthoquinone, or vitamin K<sub>2</sub>, and a water soluble product which he developed and called "vicasol." The first mentioned product is a yellow greenish powder, poorly soluble in water but easily soluble in 96 per cent alcohol and oil. From 10 to 15 mgm. of the product were given to the patient orally in the form of an alcoholic solution. This daily dose was repeated for 3 to 5 days in succession. The formula of vicasol is  $C_{11}H_8O_2SN$ , and the product appears in the form of a white crystalline powder soluble in water. It has a bitter taste, does not irritate mucous membranes, is stable, and is not decomposed by light. Vicasol was given orally in the form of tablets containing 15 mgm. of the active substance. One tablet was given daily for 4 or 5 days in succession.

Both products eliminate hypoprothrombinemia and cause a restitution of the normal blood clotting. Moreover, both products are able to stop hemorrhages from granulating wounds and lung injuries. The products proved effective also in stopping hemorrhages after tonsillectomies, arthrotomies, and stomatological operations.

## INTERNATIONAL ABSTRACTS OF SURGERY

Prophylactic administration of either product for 2 or 3 days before the operation diminishes the danger of hemorrhage after tonsillectomy. Good results were observed also after the administration of either product following surgical procedures necessitated by osteomyelitis of the upper jaw, and following war injuries. Hemorrhage during and after the operation was considerably diminished following the prophylactic use of the drugs, which also obviated the necessity of placing sponges in the maxillary sinus for the purpose of hemostasis.

The drugs are rendering good service after tooth extractions.

Both products proved efficient in stopping hemorrhages from hemorrhoids or the nose. Also, bleeding caused by pulmonary tuberculosis could be controlled by either product. Similar results were obtained in the treatment of parenchymatous gynecologic hemorrhage following endometritis, inflammatory processes in the adnexa, and also juvenile and preclimatic hemorrhages. Bleeding attributable to scurvy could be promptly stopped by either product. The healing process in superficial wounds could be accelerated by vicasol or methyl naphthoquinone.

The author's observation led him to the conclusion that the original theory concerning the mechanism of the physiologic action of vitamin K is incorrect because the vitamin or its substitutes are effective also in conditions not accompanied by hypoprothrombinemia.

JOSEPH K. NARAT, M.D.

Wells, D. B., Root, M. T., Kendall, R. E., and Leonard, J. C.: A Symposium on Burns from the Hartford Circus Disaster. *Occup. M.*, 1946, 1: 99.

The reports presented in this symposium teach a number of significant lessons in the treatment of burns.

The Hartford circus disaster, which involved the life and health of a considerable number of people, demonstrated the importance of constant preparedness for such civilian catastrophes. In large part, the favorable results obtained in the management of this group of burned patients came from wise preplanned specific organization of the community and that in hospitals. The adequate staff, aides, facilities, and supplies readily available paid large dividends and made possible the prompt exhibition of modern methods.

A Burn Committee had previously developed a plan of action for the Hartford Hospital. This and its recommended procedures were applied almost immediately. Remarkably favorable physical and emotional responses resulted from the mass method of handling this group of seriously ill and psychically traumatized people.

From the point of view of the laboratory in the management of burns, estimations of the hemoco-concentration, for the purpose of determining the

degree of shock, are essential for early function. The authors improvised a setup for securing the specific gravities by the copper sulfate falling drop technique; this was found to be of assistance in directing the use of plasma, transfusion of whole blood, and nutritional therapy.

In the author's experience, this method offered a simple, rapid, and reliable guide to the hemoco-concentration in burn shock.

DAVID H. LYKE, M.D.

Walker, J. Jr., Saltonstall, H., Rhoads, J. E., and Lee, W. E.: Toxemia Syndrome after Burns. *Biochemical and Pathological Observations and Studies.* *Arch. Surg.*, 1946, 52: 177.

Patients who have sustained severe extensive burns exhibit two reactions to their injuries—shock and toxemia. At one time it was thought that the two were one process, but it is possible to distinguish between them. Shock, occurring very shortly after the burn has been sustained, and ending usually within the first 24 hours, is marked by hemococoncentration, hypotension, tachycardia, and cold extremities; on the other hand, toxemia, appearing on the second day and usually lasting 3 or 4 days, is marked by headache, vomiting, fever, oliguria, disorientation, myoclonus, and some evidence of renal and hepatic dysfunction.

Severely burned patients admitted to the Pennsylvania Hospital, and to other Philadelphia hospitals, have been studied for signs of burn toxemia. The quantitative van den Bergh test demonstrated some hepatic damage, which was much more marked when tannic acid or some other tanning agent was applied to the burned areas than when petrolatum and pressure dressings were used. However, avoidance of tanning agents seemed to have little effect on the mortality in burn cases. Renal damage was estimated by studies of the urine and elevation of the plasma nonprotein nitrogen. All patients had some elevation. Of the 10 patients who had a level of over 100 mgm. per hundred cubic centimeters of plasma, 9 died. An "undetermined" nitrogen, the residue unaccounted for after determination of the urea, uric acid, creatinine, and alpha amino nitrogen fractions, was found to represent from 60 to 80 per cent of the rise in nonprotein nitrogen in the toxic patient and served as a useful index of the presence and severity of toxemia during the first week after the burn.

Pathological studies were made of the organs of patients who died in from 2 to 6 days after the burn, in what was clinically burn toxemia. The livers showed fatty infiltration but no actual necrosis. The kidneys showed rather pronounced toxic nephrosis with degeneration of entire tubules. In the adrenals there was no gross hemorrhage, but the inner zone of the cortex showed edema and degeneration. Gross examination of the brains showed edema and some herniation of the cerebellar tonsils through the foramen magnum with consequent compression of the medulla oblongata. Microscopic sections showed general toxic degeneration of ganglion cells,

most evident in the cortex and the hypothalamus. In general, the bodies of these patients were edematous and flabby, and the edema seemed unrelated to the amount of fluid administered therapeutically to the patient. The tissues having a high consumption of oxygen seemed to have sustained the greatest damage.

In conclusion, the authors stress the importance of the disproportionate rise in "undetermined" nitrogen, which cannot be entirely explained on the basis of renal damage. Although some deaths from burns are the result of overwhelming kidney damage, still others appear to result from damage to the central nervous system. The process of burn toxemia is a widespread one, for which no specific treatment is yet known. B. F. LOUNSBURY, M.D.

Gerber, I. E., Schwartzman, G., and Baehr, G.: The Penetration of Penicillin into Foci of Infection. *J. Am. M. Ass.*, 1946, 130: 761.

Intermittent intramuscular injections of large doses of penicillin at 3 hour intervals seem in general to be more effective in the control of bacteremia and of local infections than continuous intravenous administration of the same total daily amount.

The intramuscular administration of penicillin in divided doses has the distinct advantage of producing a higher peak level in the blood intermittently throughout the day, and thereby favors the penetration of penicillin into vegetations of acute and subacute bacterial endocarditis and into suppurative thrombophlebitis or other primary sites of bacteremia.

To assure the penetration of adequate amounts of penicillin into primary foci responsible for bacteremia (i.e., vegetations, thrombophlebitis), additional massive "booster doses" several times a day are often desirable. Such "booster doses" should be five or six times the routine intramuscular dosage which has produced blood levels sufficient to clear the blood of bacteria.

Subacute bacterial endocarditis and other chronic infections due to organisms of relatively high penicillin resistance are more advantageously treated with massive doses at frequent intervals throughout the day (every 3 hours). The minimum duration of therapy should be 5 weeks.

In purely localized infections with highly resistant organisms, such as actinomycetes, penicillin is best concentrated in a few massive intramuscular doses each day in order to favor penetration by means of exceptionally high peak levels, and, if possible, also administered directly into the infected area.

CHARLES BARON, M.D.

Trumper, M., and Thompson, G. J.: Chilling Penicillin. *J. Am. Med. Ass.*, 1946, 130: 627.

The present study was undertaken with a view to finding some method of obviating the need for the injection of penicillin every few hours. The authors state that effective blood levels can be obtained by chilling the site of the injection.

Patients with gonorrhea were studied. An ice bag of 80 ounce capacity, filled with crushed ice, was placed about the upper shoulder, fastened by a supporting harness, for a period of 2 hours, following which chilled penicillin (100,000 units in a 10 c.c. solution) was slowly injected into the deltoid muscle. The ice bag was then replaced for a period of 12 hours, refilling it as necessary. Cure of the gonorrhea and negative smears were obtained with the use of this method in 91 per cent of the cases. However, with higher doses, i.e., 150,000 units of penicillin, a 95 per cent cure should be expected.

The method used compares favorably with results reported following the use of multiple injections, or single injections of penicillin in beeswax and peanut oil.

The chilling method not only reduced, to one, the number of injections required for treatment of uncomplicated gonorrhea, but also rendered the injection painless, and made the injection of any other foreign substance unnecessary.

ARTHUR J. LESSER, M.D.

Hamilton, J. E., Prandoni, A. G., Evans, J. M., and Romansky, M. J.: Penicillin Therapy of Infections in 220 Patients. *Surgery*, 1946, 19: 186.

The Penicillin Committee at Walter Reed General Hospital, Washington, D. C., reports the use of the drug in 255 conditions in 220 patients from July, 1943 to September, 1944. Attention was directed toward large dosage rather than minimal dosage, varying from 90,000 units a day in the susceptible gonococcal, streptococcal, and pneumococcal infections, to 500,000 units a day in the more resistant staphylococcal, anaerobic clostridial, and actinomycetic infections.

Complications due to the penicillin therapy were minimal, urticaria being the most common. In no instance of 13 cases of carbuncle and furuncle was it necessary to incise and drain the infection. Among 20 cases of cellulitis and abscess of the soft tissue in general, 5 responded to penicillin which did not respond to sulfonamides. The drug was used in extensive clean or in contaminated operative cases as an adjunct to surgical procedures and was found to be of indisputable value. In skin grafting and primary closure of pilonidal sinus excision wounds its value is still to be proved.

Sequestration was prevented in 4 cases of acute osteomyelitis and an increased dosage of penicillin was suggested in all early cases. One case of penicillin cure in a patient with a brain abscess secondary to lung abscess was unique. In empyema the drug was found useful in controlling early systemic infection or accompanying pneumonia, but if pus continued to form from the tenth to the fourteenth day after penicillin had been given intramuscularly and intrapleurally, rib resection was advised and performed.

In lung abscess without lobectomy, it is the author's opinion that penicillin is vastly superior to the sulfonamides and in the great majority of the

cases the early abscess will yield to the drug. Four cases of lobectomy for lung abscess were reported. All of the patients developed a postoperative putrid empyema but all recovered.

The drug was used in a variety of medical diseases. In the actinomycetic infections there would appear to be a wide variability in susceptibility to the drug. Appraisal of its efficacy in brucellosis is withheld.

E. A. GORVETT, M.D.

Barber, M., Nellen, M., and Zoob, M.: Erysipeloid of Rosenbach: Response to Penicillin. *Lancet*, Lond., 1946, 1: 125.

Human infection with erysipelotheix rhusiopathiae, the organism of swine erysipelas, is sufficiently uncommon for any proved case to be worth recording. Recently, 7 patients with clinically diagnosed erysipeloid of Rosenbach were admitted to the hospital, and in 5 of them the diagnosis has been bacteriologically confirmed. These cases are believed to be the first in humans to be treated with penicillin, although Heilman and Herrell (1944) have successfully treated experimental erysipelotheix infection in mice with penicillin.

Of the 5 cases of bacteriologically confirmed erysipeloid of Rosenbach reported, 3 were treated with penicillin intramuscularly, which appeared to effect a complete recovery in 48 hours. These 5 cases and 2 other clinically similar ones were all admitted within a period of 4 months.

BENJAMIN GOLDMAN, M.D.

North, E. A., and Christie, R.: Acquired Resistance of Staphylococci to the Action of Penicillin. *Med. J. Australia*, 1946, 1: 176.

After testing more than 100 strains of staphylococci, Spink, Hall, and Ferris, in 1945, failed to find a single strain not previously exposed to penicillin that was not inhibited by 1 unit of penicillin per cubic centimeter. The authors, also, believe that naturally occurring penicillin-resistant staphylococci are rare. However, a large number of strains isolated from patients receiving penicillin show considerable resistance to this drug by the standard sensitivity tests. Up to this time there was no evidence to indicate whether the resistant strains were descendants of sensitive organisms already in the wound, or contaminants with naturally resistant strains or strains which had acquired resistance and become disseminated through the wards.

The authors have isolated some penicillin-resistant staphylococci which are without doubt variants of sensitive parent organisms which acquired resistance to penicillin in vitro.

When the parent penicillin-sensitive strain of staphylococci was compared with the penicillin-resistant strain, which had developed in vivo, by the mouse pathogenicity test, it was found that their killing power was identical within the limits of experimental error.

Next, the ability of penicillin to prevent death in mice was investigated. It was found that penicillin

saved the mice infected with a penicillin-sensitive strain, while similar treatment failed to save the mice infected with penicillin-resistant staphylococci. This experiment is of more value because the resistant organism is almost certainly a direct descendant of the sensitive strain. This is assumed because of the rarity of the strain, and the similarity between the coagulase formation, fibrinolysis, hemolysis, pigment formation, and serological typing of the strains.

The penicillin-resistant strain developed in vitro differed considerably from the parent strain in biological and metabolic characteristics. However, numerous subcultures on nutrient broth caused this strain to resume the characteristics of the parent strain, including its sensitivity to penicillin. When the killing doses of these organisms were investigated, the penicillin-resistant strain developed in vitro was almost completely avirulent while its parent strain killed mice to the same extent as the strains investigated in the first part of the experiment.

When a rabbit was injected with a penicillin-resistant strain developed in vitro it suffered no ill effects. The organism was recovered once from the blood stream and still found to be resistant to the same amount of penicillin. When the parent strain was injected, the rabbit died.

The authors in 2 different experiments confirmed the findings of Spink, Hall, and Ferris (1945)—that a penicillin inhibitor can be extracted from staphylococci that have acquired resistance in vivo, but not from resistant variants developed in vitro.

The results of these experiments seem to support the theory that resistance to penicillin developed in vitro is only temporary, while resistance acquired in vivo as a result of penicillin therapy is more permanent. These organisms also seem to retain their full pathogenicity.

So far there is little evidence to support the idea that these resistant strains developed in vivo have been a major cause of the failure of penicillin therapy. The authors subcultured for 30 days 6 resistant strains obtained from infected wounds without altering their resistance to penicillin, their invasiveness, and their pathogenicity. One strain was passed through animals three times and its resistance to penicillin was unchanged. The authors' work confirmed the findings of Warner and Amlexen to the effect that certain penicillin-resistant strains were as resistant to concentrations of penicillin in vivo as to those in vitro.

In the light of recent evidence in the literature and the authors' experience, it is likely that penicillin-resistant staphylococci may become a clinical problem in the future.

ROBERT R. BIGELOW, M.D.

Foshay, L., and Pasternack, A. B.: Streptomycin for Tularemia. *J. Am. M. Ass.*, 1946, 130: 393

It is noteworthy that each of the first 6 patients given streptomycin for tularemia experienced relief from the distressing general symptoms of headache, mental dullness, the sense of prostration, arthralgia,

myalgia, chills or chilly sensations, and nausea before the end of the first day of therapy. This effect was a striking feature by the end of the second day, and it appeared even with very low, possibly suboptimal, dosage. The authors infer that bacteriostasis, which must undoubtedly have occurred within the first 12 hours of therapy, is associated with failure of the bacteria to elaborate the diffusible substances that lead to the production of these symptoms. Failure of papular primary lesions to ulcerate, even after incision, seems also a result of bacteriostasis or a regional bactericidal effect.

It is probable that the authors gave too little streptomycin, or gave it for too short a period, to obtain the best possible results in several cases.

Administration by continuous subcutaneous drip, which seems to be tolerated better than continuous intravenous drip, would have been more effective than intermittent intramuscular administration in securing high initial blood and tissue concentrations, the most important factors for successful therapy with all bacteriostatic and bactericidal agents.

The authors were unable to determine streptomycin concentrations in the blood or serum at the time these patients were treated. From later studies they infer that the administration of 30,000 units every 3 hours maintained concentrations between 2 and 4 units per cubic centimeter of serum during the period of administration.

*Comparison with serum therapy.* Comparative estimates of the effects of these therapeutic agents were unavoidable. With due regard for the small size of the streptomycin series, one feature was outstanding: the uniformity of the clinical responses in character, degree, continuity, and time of appearance. Although the authors have records of serum treated patients that compare favorably with the cases recorded here, these cases could not be matched by any 7 case records of the serum treated patients selected at random.

The responses to serum therapy have always shown a wide range of variability in character, degree, continuity of effect, and time of appearance. This has been attributed chiefly to variability in the efficiency of individual defense mechanisms as they were aided by a bacteriostatic agent. The administration of a bactericidal agent that acts directly on bacteria and independently of the variable, individual defense mechanism possibly accounts for the observed uniformity of the responses to streptomycin.

JOHN J. MALONEY, M.D.

Miller, C. P., and Bohnhoff, M.: Streptomycin Resistant Cocci. *J. Am. M. Ass.* 1946, 130: 485.

Drug resistance or "fastness," that is, the acquisition by micro-organisms of tolerance for chemotherapeutic agents, has long engaged the attention of bacteriologists and parasitologists and has recently become a matter of concern among clinicians and epidemiologists. Resistant strains of micro-organisms usually susceptible to the sulfonamides have been recognized for some time, and penicillin resist-

ant strains are now beginning to appear in the clinic and laboratory. The apprehension which might have been caused by the latter is currently being allayed by the introduction of streptomycin.

It should be pointed out that the observations have been made on micro-organisms which have been rendered drug resistant by artificial means, and that these findings must not be assumed to apply by analogy to naturally resistant strains if and when they arise. The relation of artificially acquired and naturally acquired resistance to chemotherapeutic agents involves many questions as yet unanswered.

Repeated cultivation of gonococci and meningococci on mediums containing increasing concentrations of streptomycin enhanced their streptomycin resistance rapidly—within 4 to 6 transfers—to such a degree that growth occurred on concentrations of 75,000 units per cubic centimeter, the highest concentration employed. These streptomycin resistant meningococci remained fully virulent for mice and produced lethal infections with generalized sepsis in spite of treatment with 15,000 units of streptomycin, the maximum dosage tolerated by the animals. Similar infections with the same strains before they had become resistant were regularly cured by doses of from 70 to 100 units of streptomycin.

Streptomycin resistant meningococci were susceptible in vitro and in vivo to penicillin, and penicillin resistant meningococci were susceptible to streptomycin in vitro and in vivo.

Gonococci resistant to either drug were susceptible to the other in vitro.

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JOHN E. KIRKPATRICK, M.D.

Weinstein, L.: Typhoid Bacillus Infection of a Surgical Wound; Treatment with a Urethane-Sulfanilamide Mixture. *N. England. J. M.*, 1946, 234: 184.

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The manner in which the enteric pathogenic bacteria gained entrance to the wound is open to conjecture. It seems probable that the organisms were not brought to the site of operation by the blood stream, since, if it is assumed that the original illness 3 weeks previously was typhoid fever, the bacteriemic stage should have been over for an appreciable time.

It has been demonstrated that the eberthella typhosa is extremely susceptible to the action of urethane.

Treatment of the local infection with a solution containing 10 per cent urethane and 1 per cent sulfanilamide led to rapid eradication of the infecting bacteria and healing of the wound.

The importance of localized areas of suppuration due to the eberthella typhosa cannot be overemphasized because, unless promptly recognized bacteriologically and the necessary precautions taken, spread of typhoid fever may occur.

HARRY W. FINK, M.D.

Boyd, J. S. K.: Tetanus in the African and European Theaters of War from 1939 to 1945. *Lancet*, Lond., 1946, 1: 113.

The object of this report is to assess the incidence of tetanus in the European and African campaigns of 1939-45; to ascertain as far as possible the extent to which this has been influenced by active and passive immunization; to examine the effect of immunization on the severity of the disease; to discuss the failure of active immunization in preventing the development of tetanus in certain cases; and to consider the results of various forms of treatment and other matters of lesser importance.

The report is based on the records of 103 cases of tetanus in British, Indian, Dominion, and Colonial land forces, in a few Allied troops, and in prisoners of war during military operations in the European and African theaters of war. Most of the patients were battle casualties. Passive immunization against tetanus by inoculation with tetanus antitoxin was used for the first time on a large scale in the war of 1914-18, and its value as a prophylactic measure was fully tested and proved.

It was found that 2 doses of 1 cubic centimeter of a potent toxoid, given at an interval of 6 weeks, produced in most cases a level of circulating antitoxin believed to be adequate to afford temporary protection, and at the same time called into permanent existence a defensive mechanism capable, when stimulated by the presence of further quantities of toxoid (and presumably toxin), of turning out large quantities of antitoxin. Subsequent doses of toxoid produced both a higher level of circulating antitoxin and a more sensitive and more readily stimulated defensive mechanism.

Active immunization against tetanus by means of 2 doses of 1 cubic centimeter of tetanus toxoid given at an interval of 6 weeks was officially introduced into the British Army in 1938, and it is estimated that at the time of the German invasion of Belgium

and France, when the first heavy casualties were incurred, about 90 per cent of the troops on the Continent were protected. Although the advantage of a third dose was fully realized, this was not made a standard procedure until January, 1941, mainly owing to difficulties in procuring the necessary supplies of toxoid. In the Middle East (the theater in which most casualties were being incurred at that time) this order took long to implement, because of the inevitable delay, through transport shortage, in getting supplies from home. Finally, in November, 1942, instructions were issued for an annual "boosting" dose of 1 cubic centimeter of toxoid to be given to all Service personnel. Before the invasion of Europe, the troops in 21 Army groups were practically 100 per cent inoculated. As an additional precautionary measure, a special order was issued, which required that every man who had not already received one or more boosting doses—i.e., every man who had received only the initial 2 doses—should be given a third dose before going overseas. A few managed to elude the net, but their number was small.

Passive immunization was maintained as an additional precaution. Any wounded man who was not actively immunized was given 3 doses of 3,000 international units of antitoxin at weekly intervals. Actively immunized men were given a single dose of 3,000 units as soon as possible after wounding. The object of this dose was to tide the man over the first critical week, during which his circulating antitoxin might be below the safety level. This procedure of combined active and passive immunization was adopted in the United Kingdom, and in the Australian, New Zealand, and Indian armies. In South African troops (U.D.F.) passive immunization alone was used until 1942. In the Canadian and American Army forces, the troops were actively immunized in the same way as in the British Army; however, when wounded they were given, not antitoxin, but a further boosting dose of 1 cubic centimeter of tetanus toxoid, with the object of stimulating rapid antitoxin production.

An analysis of this study indicates that the incidence of tetanus in the African and European campaigns has been negligible. This is attributable chiefly to active immunization with tetanus toxoid.

Active immunization did not prevent the development of tetanus in 22 cases. The case mortality rate among actively immunized men did not fall below the average, but it is noteworthy that the majority of fatal cases were in colored troops.

The case mortality rate in actively immunized men who were given prophylactic antitoxin was significantly lowered.

The duration of the symptoms in actively immunized men who survived was also significantly lowered.

The incubation period in actively immunized men rarely exceeded 10 days, whereas in most of those who were not actively immunized, the incubation period was more than 10 days.

Failure of active immunization appears to be attributable to an inadequate level of circulating

antitoxin in the early stages of infection and is more likely to be remedied by prophylactic antitoxin than by a "booster" dose of toxoid.

Therapeutic antitoxin, to be effective, must be given early in large doses by the intravenous route.

Sedatives, including avertin and pentothal, did not influence the course of the disease, although they were effective in relieving symptoms.

BENJAMIN GOLDMAN, M.D.

## ANESTHESIA

Waters, R. M.: *Anesthesiology. J. Am. M. Ass.*, 1946, 130: 909.

Certain abuses associated with anesthesiology are common and accepted practices in our country. Exploitation of the patient by the hospital or anesthetist does exist. And often the qualified medical specialist in anesthesia has not the recognition, as a professional member of the medical staff, that he is entitled to. There is often domination of this department by hospital executives or others whose vision of the ideal is blurred by the desire to avoid entries on the debit side of the ledger. It is important to avoid exploitation, and to be sure that sufficient funds are set aside or collected to pay adequately for good service in anesthesiology.

Several organizations of anesthesia service are suggested; the scope of departmental organization and the size of the institution will determine the number of individuals needed. Of importance are the teaching and research possibilities of the specialty. These should be given proper emphasis. Much wasted effort in unnecessary experimentation can be avoided by interdepartmental friendship and understanding throughout the medical school and hospital.

The public as a whole is not receiving the best service that anesthesiology is capable of supplying. This is probably due to the insufficient number of anesthesiologists available. This deficiency is due to a variety of abuses which have become common practice in the hospitals of this country. Proper instruction of undergraduate and graduate students in our medical schools and hospitals is one method leading to improvement and the other is organization of departments in medical schools and hospitals.

This article is a plea to correct the abuses of this specialty at this auspicious time when hundreds of medical officers interested in anesthesiology are returning from war.

MARY KARP, M.D.

Monhelm, L. M.: *Anesthetic Procedures Used in a General Hospital in the Communication Zone with an Analysis of 2,000 Anesthesias. Current Res. Anesth.*, 1946, 25: 67

This is a review of the first 2,000 anesthetics administered in a General Hospital in the Southwest Pacific Theater. Its purpose is to study the technique used and the results obtained, as well as to define the duties of the anesthesiologist.

The anesthetic section has as its duties the establishing of surgical anesthesia, the performance of

diagnostic and therapeutic "blocks," and the administration of intravenous fluids in the operating rooms and oxygen therapy throughout the hospital.

Of the 2,000 anesthetics given, 805 (40%) were by regional methods, 856 (42%) were general; 270 (14%) were local infiltrations, and 69 (4%) were given by combined methods. Four hundred and forty seven of the regional cases were spinal anesthetics and gave gratifying results. The effectiveness of spinal analgesia depends upon the knowledge of the various techniques and the proper selection of cases.

Cervical plexus block and brachial plexus block are described in detail, with a discussion of the new technique for brachial plexus injection. This technique is a combination of the technique used by Lundy and McCluskey, plus a few personal innovations. It has been successful in more than 90 per cent of the 74 cases in which it has been used. It involves the use of 3 needles, the first one contacting the first rib at a point half a finger breadth above the clavicle and just lateral to the subclavian artery. The second and third needles are placed 1 and 2 finger breadths, respectively, posterior and slightly lateral to the first needle, neither exceeding the first needle in depth. A total of 50 c.c. of 2 per cent metycaine solution is used for the block. Procaine or metycaine was the drug used for spinal anesthesia. Of the 856 patients who received general anesthesia, 833 were given pentothal intravenously. It was believed that inhalation anesthesia was less suitable for use in the tropics than regional methods. Nineteen different types of combined anesthetics were used for 69 cases. The most frequent combinations were regional anesthesia plus enough pentothal to keep the patient asleep or drowsy.

Complications were kept at a minimum. The immediate complications included laryngeal spasm, which occurred during pentothal anesthesia, and an occasional depression of the respiration. There was only one complication of pneumothorax following regional anesthesia. Postanesthetic headaches occurred in 3 per cent of the spinal cases.

MARY KARP, M.D.

Fraser, R. J.: *Continuous Lumbar Anesthesia with the Dilution Technique. Current Res. Anesth.*, 1946, 25: 58.

This article describes a technique for spinal anesthesia with dilute solutions gained from more than 6 years of experience in 3,000 personal administrations with no anesthetic mortality. Two thousand of these anesthetics were given with the continuous technique. The dilute solutions were used because it was believed that they produced less metabolic change, fewer discomforts, and less morbidity in the patient.

The agents, employed singly or in combination, were procaine, pontocaine, percaine, or dilute nupercaine, and the method with which these agents were used was described in detail. A 1 per cent solution of procaine in saline solution especially prepared for lumbar anesthesia was the drug of choice. With this solution the volume is larger and the interval be-

tween injections is closer than with the concentrated solution of procaine. The second injection was usually required 30 minutes after the initial injection when procaine was used and again 15 to 20 minutes thereafter. As much as 35 c.c. of a 1 per cent solution of procaine has been given in chest surgery at one dose with no respiratory paralysis. The continuous technique offers more safety than the single dose technique, and the dilute technique offers a safer procedure than the concentrated technique since the former has less effect on the respiratory, cardiac, and vasomotor systems. No barbotage was used.

Stress was made on the necessity of maintaining a continuity of the continuous lumbar apparatus. Pressor drugs were not used routinely, but were indicated in aged and hypersensitive patients, and included ephedrine, epinephrine, ephedrine-pitressin combination, neosynephrin, and methedrine.

The technique of combining nupercaine procaine or pontocaine glucose was discussed. When pontocaine and glucose were the agents used, a 0.2/10 solution or 0.1/10 per cent solution was found to have the same anesthetic potency as the 1 per cent procaine solution. So far, no intercostal paralysis has resulted from the more dilute 0.1 per cent solution. The use of dilute nupercaine is still in the experimental stage.

The largest volume of procaine in the series was 60 c.c., and the longest anesthesia reported was 5 hours.

MARY KARP, M.D.

Evans, F. T.: Sepsis and Asepsis in Spinal Analgesia. *Proc. R. Soc. M., Lond.*, 1946, 39, 181

It is the author's opinion that when sepsis occurs in spinal analgesia, the infective material is conveyed through the lumen of the spinal needle because of some avoidable failure in the anesthetist's technique. The author also stresses the question of asepsis.

There are many points at which the technique can break down. Septic matter can enter the spinal canal as the result of spinal puncture as follows:

1. From the hands of the anesthetist
2. From the skin of the lumbar area
3. From the imperfect sterilization of syringes and needles
4. From contamination of the needles and syringes
5. From a hematoma caused by repeated attempts at spinal puncture

The wisest course is to scrub the hands with soap and water as for any surgical procedure, rinse them in alcohol for 2 minutes, and allow them to dry. Furthermore, the use of sterile rubber gloves, put on in the proper manner, is recommended.

With regard to skin preparation, the preferred method is washing with soap and water, this being followed by the application of tincture of iodine and alcohol. Since it is possible for organisms to be carried in by the needle, either on the point or just inside the lumen of the point, the Sise introducer may be used as a precaution.

The syringes and needles are used for nothing but spinal punctures. All-glass syringes are recom-

mended as infected clots or organisms can lodge in the interstices of the cement in other types and it is difficult for the sterilizing fluid to penetrate these areas. The best method of sterilization is with dry heat or autoclaving. If this is not possible, boiling for 5 minutes in water is reasonably safe, distilled water being used to avoid the risk of an alkaline reaction which will precipitate the anesthetic as its insoluble base.

Distilled water employed for rinsing needles and syringes must be taken from a new bottle that has been freshly sterilized, as organisms can be found in the water after the bottle has been opened for a few hours.

Anesthetic solutions in ampoules are safest, but there is a source of infection via the ampoule. This is the paper label, which will float off in aqueous solutions, and the organisms imprisoned under the label are released and thus form a source of infection. Ampoules may be kept in 70 per cent alcohol or their outer surface may be sterilized by immersion in formalin vapor for 24 hours.

There is some evidence of the occurrence of "chemical meningitis," but this is thought to be negligible.

Direct handling of the ampoules is avoided and the needle is introduced into the ampoule without its touching the exterior.

With proper technique, the risk of infection is negligible, but if there is any deviation from this, infection can occur, and sometimes with disastrous consequences.

MARY FRANCES FOR, M.D.

Griffith, H. R.: The Physiological and Clinical Action of Curare. *Current Res. Anesth.*, 1946, 25, 45.

This article reviews the history of the present knowledge of the clinical use of curare, with special reference to its use in anesthesiology. The curare effect is observed usually within a minute after the injection is made, reaches its peak in about 5 minutes, and then in 20 minutes it gradually disappears. The proper dose depends upon the anesthetic agent which is used, the size and age of the patient, and the individual susceptibility to the drug. When ether is the anesthetic agent used, curare causes more respiratory depression than when it is used as an adjunct to cyclopropane alone. Pentothal does not have the same curariform action as ether, but care must be employed to maintain an adequate respiratory exchange when curare is added to pentothal anesthesia. There is less margin of safety between the effective dose and the overdose in young children than in adults. Fail or seriously ill adults seem to stand the drug as well as robust ones, and need as large a dose in proportion to weight.

The usual initial dose in adults is between 3 and 3½ c.c. Five cubic centimeters is the maximum dose for one injection. Large doses probably bring on the central action of curare rather than the desired peripheral action. Disappointing results follow an attempt to give initial doses smaller than 3 c.c. to

adult patients under cyclopropane or other gas anesthetic agents.

The author has personally administered curare to 700 patients. It is used as an adjunct to cyclopropane in 40 per cent of all abdominal operations. It is useful in facilitating endotracheal intubation in cases in which there is much muscular rigidity, in overcoming the tight anal sphincter in hemorrhoidectomies, in aiding pelvic examinations in obese patients, and in relaxing a conscious muscular patient who is to have a bronchoscopy.

Curare has two actions. The well known peripheral action and the central action on the brain. The peripheral action is due to an interruption of the nerve impulse at the neuromuscular junction, probably a blocking or neutralizing of the acetylcholine reaction. Curare thus prevents the effector substance of voluntary muscle from reacting to acetylcholine, and also blocks synaptic transmission between preganglionic and postganglionic fibers of the sympathetic division of the autonomic nervous system.

Evidence of the central action of curare is based upon recent clinical results following the administration of large doses to patients and the findings in recent laboratory experiments. When large doses were given, complete paralysis of all skeletal muscles resulted with an abrupt loss of consciousness without any preceding period of analgesia. Evidence points to the independent nature of the central and peripheral actions. Prostigmine was not believed to be a necessary antidote to overdose of the drug.

An occasional bronchial spasm resulted from the use of curare. Among the author's 700 cases, 3 bronchial spasms were observed.

There is no contraindication to its use. It may be administered to any patients in whom extra muscular relaxation is needed. Sternal injection may be used when the veins are inaccessible.

The sure but transitory action, with rapidity of elimination and no after effects, makes the use of curare a great benefit to the anesthetist and appears to give this drug a permanent place in anesthesiology.

MARY KARP, M.D.

## SURGICAL INSTRUMENTS AND APPARATUS

Jenkins, H. P., and Clarke, J. S.: Gelatin Sponge, A New Hemostatic Substance; Studies on Absorbability. *Arch. Surg.*, 1945, 51: 253.

Hemostasis is a fundamental principle in surgical technique. It can be satisfactorily obtained in most instances by ligature, clips, pressure, electrocoagulation, and packs. There are some situations, however, in which venous or capillary bleeding may be difficult to control by these methods.

The major recent advances in the problem of control of capillary and venous oozing have been the development of coagulating agents, such as thrombin, and the use of absorbable substances which will aid in clot formation by purely mechanical means, such as transmitting pressure to the bleeding surface and offering a matrix for the formation of the clot.

The work of Seegers and his coworkers deserves special mention as a major contribution to the problem of hemostasis. They have developed a method of preparing a purified thrombin, which is now commercially available and, furthermore, they have worked out a method of calibration and standardization of the potency of the thrombin known as the Iowa unit.

The most recent of the absorbable hemostatic materials is gelatin sponge or foam. This is prepared from ordinary commercial gelatin, which is made up in a solution to which a hardening agent is added. After bubbles of air are introduced, the mixture is allowed to dry in pans. It can then be cut into any desired size or shape. The material, which has been used for experimental purposes, is provided in sealed glass jars previously subjected to sterilization with dry heat.

The gelatin sponge is a white crisp material which is extremely light in weight. One cubic centimeter weighs 9 mgm. The sponge will take up many times its weight of water when it is submerged and the air bubbles are expressed.

When moistened, the gelatin sponge shrinks and becomes soft and pliable. It easily adjusts itself to any irregularities in the surface to which it is applied. It does not fragment easily, although it is not especially tough.

An experiment was devised primarily to determine the behavior of the gelatin sponge in the tissues of animals and the response of the tissues to the gelatin. To avoid the introduction of an additional factor in this evaluation, the gelatin sponge was used without thrombin.

These experiments have demonstrated that gelatin sponge is a bland substance which is generally slowly absorbed in the tissues over a period of about 5 weeks.

The presence of a conspicuous number of polymorphonuclear leucocytes would generally lead to rapid absorption of the sponge within a few days or a week by a liquefaction process.

The magnitude of the tissue reaction to the gelatin sponge during the period of absorption was generally less than that observed for surgical gut.

Gelatin sponge has a definite hemostatic action per se when applied to bleeding surfaces with moderate pressure.

Gelatin sponge or foam appears to have properties which make it suitable as an absorbable hemostatic substance, and deserves clinical trial in the varied fields of surgery to further evaluate its merits and limitations.

JOHN E. KIRKPATRICK, M.D.

Lowry, M. L.: Synthetic Adhesives in the Treatment of Wounds of the Liver and Other Surgical Conditions; A Preliminary Report. *Arch. Surg.*, 1946, 52: 160.

With a view to finding a hemostatic agent capable of controlling hemorrhage from extensive wounds, the author has performed experiments on rabbits, and has used commercial Scotch tape to cover de-

fects left by the excision of segments of the liver. Seventeen animals were operated upon and large wedge-shaped portions of their livers were cut away. No attempt was made to bring the two cut surfaces together or to control the bleeding in any way, nor was the tape applied to the raw surfaces of the liver. Instead it was placed on the upper and lower surfaces of the liver and brought out over the defects to the edge of the liver in such a manner as to enclose completely the area from which the excision had been made. One rabbit died of peritonitis on the fourth day. In contrast to this, 8 of the 11 control animals died of hemorrhage within 12 hours; the 3 control rabbits which survived had the smallest liver wounds.

Commercial Scotch tape consists of three layers: the backing, usually cellophane; the filler, rope stock paper; and the adhesive face, crude rubber or some synthetic substitute. Eleven types of tape were tested—the regularly available types and some specially synthesized tape for experimental purposes by the manufacturer. In addition to being used in the animal experiments mentioned, the tapes were tested for absorbability by introducing samples of them into the peritoneal cavities of rats and leaving them there for a month. They were also subjected to sterilization by means of autoclaving.

When the sixteen surviving rabbits were examined, from 1 to 5 weeks after operation, none showed signs of intraperitoneal bleeding or visible residues of the tape. A few showed slight adhesions of the

intestine to the liver scar. The liver wounds had healed well. When the hepatic scars were sectioned for microscopic study a small abscess or a caseous residue surrounded by fibrous tissue was the usual finding, apparently representing the unabsorbed components of the tape. The synthetic resins type of adhesive agent had the greatest hemostatic effect. The most satisfactory type of tape, although it was not completely absorbed, was one of polyvinyl alcohol backing, rope stock filler, and adhesive synthetic resins. The tape samples left in the peritoneal cavities of rats were completely absorbed at the end of one month and produced no tissue reaction. All of the tapes were found capable of withstanding sterilization by autoclaving, but some lost varying degrees of elasticity, flexibility, and adhesiveness in the process.

This type of tape has many potential surgical uses, as a hemostatic agent in wounds with diffuse bleeding, and as a simple mechanical method for holding together the ends of severed nerves, tendons, and possibly vessels. Of the requirements for a product that will be suitable for use in humans, namely, complete absorbability, minimal tissue reaction, great adhesive capacity, good hemostatic effect, and susceptibility to chemical and thermal sterilization, some of these have already been attained. The author believes that with continued investigation, the other desired properties can be obtained.

B. F. LOUGHRAN, M.D.

# PHYSICOCHEMICAL METHODS IN SURGERY

## ROENTGENOLOGY

Camiel, M. R.: Roentgenology of the Draining Bronchi from Tuberculous Cavities. *Radiology*, 1946, 46: 24.

The diagnosis of involvement of the bronchi draining tuberculous cavities is, as a rule, based on clinical evidence, bronchoscopic findings, and a few indirect roentgen signs. The author, in studying a rather large number of cases, came to the conclusion that there are also characteristic direct roentgen signs which may be utilized to advantage.

The part of the lung which lies between the hilum and a certain tuberculous cavity contains the regional bronchi and the peribronchial vascular and lymphatic channels which drain the area of parenchymal involvement toward the root of the lung. That the draining bronchi themselves may be involved by the tuberculous process is now generally recognized. Some investigators, as a matter of fact, are of the opinion that they are almost always involved.

The mode of involvement of the bronchi is not clear. There are several theories for its explanation. The author believes that it is the result of direct extension from the cavities they drain by implantation from the infected material.

The roentgen appearance of involvement of the draining bronchi depends on the severity and duration of the underlying tuberculous process. In the early stages the edema or slight inflammation of the bronchus is reflected in a simple increase of the bronchial shadow. The often observed rapid clearing up of such a shadow suggests either a nonspecific process or a very minimal tuberculosis. Later, submucous extension develops with elevation of the bronchial mucosa and thickening of the bronchial wall. At this stage roentgen study reveals two closely related, dense, parallel lines, separated by a central shadow caused by the lumen. Tomography is of great help in bringing out this feature of the roentgen appearance. Still later, ulceration develops and is associated with an irregular granulomatous growth above the surface. Such a process is identified on the roentgenogram by a dense irregular widened bronchial shadow with an irregular narrowing of its lumen. A peribronchial reaction may also be present.

At times one may not be able to outline the bronchus clearly, but even so the shadows between the cavity and the hilum are attributed to the involvement of the draining bronchi. With continued advance of the tuberculosis the ulcerogranuloma completely occludes the bronchus, which leads to peripheral atelectasis. Finally, caseation sets in with necrotic bronchitis, and gives rise to very thick bronchial and peribronchial shadows. The clearing of the extensive disease is reflected by a reversal of the roentgen findings until a gradual return to

normal is reached, although the fibrous residua may leave their marks indefinitely. T. LEUCUTA, M.D.

De Balsac, R. H., and Pannier, R.: Cardiovascular Radiokymography; Its Usefulness and Its Future (La radiokymographie cardiovasculaire; son utilité et son avenir) *Rev. belge sc.med.*, 1945, 16: 1.

Radiokymography offers two ways of picturing the movements of the heart and the great vessels. In the first a screen with horizontal slits is interposed between the thorax and the photographic plate. The screen is slowly moved down vertically till the whole plate has been exposed. A picture of all parts of the heart in various phases is thus obtained. In the second method, the screen is stationary and the plate is moved till fully exposed. The resulting picture shows the movements of particular areas of the heart in its various phases. The kymogram enables us to distinguish clearly between moving and nonmoving contours.

The clinical importance of this diagnostic method is still open to question as the interpretation of the kymogram presents considerable difficulties. However, valuable contributions seem to be possible in cases of coarctation and stenosis of the aorta, in localization of foreign bodies in the wall of the heart, and in valvular diseases. This article deals especially with the radiokymographic findings of myocardial infarcts, and the systolic dilatation of the left auricle in mitral disease. WERNER M. SOLMITZ, M.D.

Hendelberg, T.: The Roentgenographic Examination of the Ankle Joint in Malleolar Fractures. *Acta radiol.*, Stockh., 1946, 27: 23.

A number of different studies of the mechanism of various ankle fractures and dislocations and of their anatomical basis are loosely linked together in this article, the material being mainly from the author's thesis on fractures of the posterior margin of the tibia.

Some of these investigations may be summarized as follows:

1. *Purpose of the investigation.* The determination of the origin and insertion of the anterior tibiofibular ligament, and of its relation to the common oblique fracture of the tibia.

*Method.* Radiography of an anatomical preparation in which the ligament was marked by a wire.

*Findings.* This type of fracture often reaches below the insertion of this ligament. If the malleolus can be displaced laterally by manipulation, the ligament is invariably torn even if the fracture does not reach below the ligament.

2. *Purpose of the investigation.* Study of the lateral and medial malleolar ligament insertions for better understanding of the arthograms.

*Method.* Radiography of an anatomical preparation from which the posterior joint capsule was removed.



**Findings.** The medial ligament inserts on the astragalus at the level of the distal part of the trochlea tali. The lateral ligament inserts at the level of the subtaloid joint.

3. **Purpose of the investigation.** Study of the injuries to ligaments caused by malleolar fractures.

**Method.** Manipulation of fractured ankles under fluoroscopic control.

**Findings.** In 31 of 42 cases examined a tendency toward dislocation was observed. The dislocation could be produced by pronation-abduction in 24 cases, by supination-adduction in 2, by supination in 2, and by uncertain or unidentified motion in 3 cases.

4. **Purpose of the investigation.** Comparison of the mobility and "dislocatability" of the injured ankle with that of the uninjured one of the same patient.

**Method.** Manipulation under fluoroscopic control.

**Material.** Approximately 250 cases with fresh or old (follow up) ankle injuries.

**Findings.** Only one control ankle displayed a slight instability of the talus. No instability of the talus in plantar flexion was observed in any control ankle, although it had been described as a normal feature by many anatomists.

**Conclusion.** A mobility of the talus which permits widening of the talofibular space under manipulation is pathological.

5. **Purpose of the investigation.** Correlation of the fluoroscopic findings in 4 to specified ligament injuries.

**Method.** Arthrography by means of injection of 3 c.c. of perabrodil into the joint.

**Material.** Same as in 4.

**Findings.** In 15 of 16 cases in which the attempt at dislocation of the injured ankle failed or in which the fractured malleolus accompanied the talus in dislocation, no leakage of contrast material occurred. In 9 of 10 cases with gross abnormal mobility of the talus, leakage was clearly observed.

Failure of contrast material to escape into the surrounding tissues in some cases of abnormal "dislocatability" was probably caused by blood clots because it occurred in cases in which the examination was performed 24 hours after the injury or later. Nonleakage in cases of abnormal mobility not exceeding 1 or 2 mm. (observed in a few instances) is probably explained by stretching of the capsule without rupture.

6. **Purpose of the investigation.** Determination of the roentgenographic visibility of the widening of the tibiofibular space (which is said to occur in many ankle injuries).

**Method.** Insertion of wooden wedges between tibia and fibula.

**Findings.** The widening cannot be seen on regular anteroposterior ankle films because of the obliquity of the contours. Escape of contrast material along the interosseous membrane sometimes indicates this.

**Conclusion.** Fluoroscopic manipulation and arthrography are necessary for the x-ray diagnosis of rupture of the tibiofibular ligament.

7. **Purpose of the investigation.** Determination of how tilting or dislocating the talus influences the tibiofibular ligament and space.

**Method.** Postmortem experiments and the testing of 1 case in vivo.

**Findings.** Dislocation of the talus does not widen the tibiofibular space.

8. **Purpose of the investigation.** Evaluation of the roentgenographic visibility of posterior tibial fragments.

**Method.** Postmortem experiments with artificial fractures and clinical roentgenographs of 160 cases.

**Findings.** Only in 27 of the 160 cases were the fragments clearly outlined.

**Conclusion.** Films of the ankle in oblique posterolateral projection should be taken in all cases of ankle injury.

Further studies concerning fractures of the malleolar arches are discussed in detail.

GERRHART S. SCHWARTZ, M.D.

Overgaard, K.: On Bechterew's Disease from the Roentgenological Point of View. *Acta radiol., Stockh.*, 1945, 26: 185.

The author briefly reviews the pathology of ankylopoietic spondylarthritis, or Bechterew's disease, and stresses its frequently insidious onset, its predilection for young adult males, the pain in the spine with gradual development of poker spine, especially in the lumbar region, fixation of the ribs, and later involvement of the joints of the extremities.

He points out that the few cases reported as coming to autopsy relatively early in the disease process have shown an inflammatory arthritis first affecting the small intervertebral joints, which ultimately results in fibrous and then bony ankylosis, with accompanying deposition of bone in the vertebral ligaments. Whereas the state of the sacroiliac joints is not mentioned in these early autopsies, the author believes there is roentgen evidence pointing to similar early involvement of these joints, which is much more easily recognizable in films than in the small intervertebral joints where such changes can at best be brought out only with a careful search of special oblique views.

He bases his opinion on a study of 31 personally observed cases (28 males and 3 females) and gives the roentgen details in 8 of these cases. Early in the disease there were scattered opacities in bone about the sacroiliac joints with slight, spotty decalcification of subchondral osseous tissue and blurring of the articular surfaces. Confluence of the small rarefactions may result in an apparent increase in cartilage space. As decalcification spreads in some areas, sclerosis increases in others, and bony bridges begin to cross the articular interspace. Gradually this process progresses until the joint architecture is effaced by osseous ankylosis.

He also calls attention to the fact that although the fibrocartilaginous tissue in the center of the discs degenerates as the disease progresses, the vertebral interspaces usually do not become narrowed, as

in simple fibrous degeneration, probably because by the time this change intervenes the distance between the vertebrae has become fixed as a result of articular and ligamentous change, manifested in the roentgenogram by intervertebral bridging and not to be mistaken, in the author's opinion, for the long osteophytes often seen in ordinary osteoarthritis.

After reviewing the results of roentgen therapy in this disease as reported in the literature, the author relates his own experience in the treatment of 15 patients with rather severe cases, who also received intensive medicinal and physical therapy. Irradiation was given over the sites of pain, with special attention to joints in which it was important to maintain mobility, such as the cervical and atlanto-occipital joints, and those of the hip and shoulder. Single doses of from 150 to 200 r. (180 kv., 1 mm. of copper plus 1 mm. of aluminum), repeated once to a given field, or one dose each to an anterior and posterior portal, constituted the usual course, and if a satisfactory effect was not obtained the course was repeated after from 3 to 6 weeks. A considerable analgesic effect was obtained in all cases, and as a consequence patients were able to tolerate more active physiotherapy. A follow-up of 10 cases after from 1 to 4 years showed that the gains made had been maintained in all but 1 incompletely treated case. The patients had little pain, and mobility in the joints of the extremities was good enough to permit them to work. LILLIAN DONALDSON, M.D.

Nielsen, J.: Roentgen Treatment of Malignant Tumors of the Nasopharynx. *Acta radiol.*, Stockholm, 1945, 26: 133.

The author reports his experience with 77 cases of malignant nasopharyngeal tumors, 75 of which had been examined histologically. This represents the total number of cases of this kind referred to the Radium Center in Copenhagen from 1931 to 1941, and 0.75 per cent of all malignant affections treated in this institute over this period. Several histological classifications in the examined tumors are given, one of which is as follows:

Lymphoepithelioma	22 cases
Reticulosarcoma	13 cases
Lymphosarcoma	7 cases
Basal cell carcinoma	12 cases
Squamous cell carcinoma	20 cases
Cylindroma (cylindrocellular carcinoma)	1 case
Not examined	2 cases

All cases were treated with x-rays exclusively in fractionated doses to two lateral portals (including the base of the skull and the neck) and usually to two additional frontal portals with the eyes protected. As a rule, two treatments were given per day. The single treatment dose varied between 75 and 200 r./air. In most cases the radiation was a heavily filtered (Thoraes filter) 180–200 kv. beam. The target skin distance was between 50 and 70 cm. and the intensity varied between 2.5 and 7.5 r./air per minute. The tumor doses as stated in the case histories (not all of the cases are reported) ranged

from 1,800 r. to 5,400 r. Additional treatments were given to recurrences and metastases.

The results in the 37 cases which were treated up to 1936 were as follows:

TABLE I.—ROENTGENOLOGICAL RESULTS IN 37 CASES OF NASOPHARYNGEAL TUMOR OBSERVED FROM 1931 TO 1936.

Symptom-free after 5 years	9 (24 per cent)
Alive with recurrence after 5 years	2 (5 per cent)
Died within 5 years	26 (71 per cent)

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TABLE II.—FIVE-YEAR RESULTS OF ROENTGENOLOGICAL TREATMENT IN 37 CASES, IN RELATION TO THE HISTOLOGIC TYPE OF THE NASOPHARYNGEAL TUMOR.

Lymphoepithelioma	4 of 15	} Sarcomas: 7 of 25 (28 per cent)
Reticulosarcoma	2 of 7	
Lymphosarcoma	1 of 3	
Basal cell carcinoma	2 of 2	} Carcinomas: 2 of 9 (22 per cent)
Squamoepithelial carcinoma	0 of 9	
No microscopy	0 of 1	

Sixty-seven of the 77 patients either had lymph node metastases when they were first seen or they developed them after the treatment. In 25 cases distant metastases could be demonstrated with certainty in one or more of the following locations: bones (12 cases), mediastinum and lungs (8 cases), liver (3 cases), and abdominal glands (7 cases). The author concludes: (1) that roentgen therapy is at present the method of choice; (2) that supplementary intracavitary treatment will probably not improve the results since the dose distribution is adequate; and (3) that in cases of lymphoepithelioma the necessary tumor dose depends on the treatment time. It rises with the treatment time, e.g., it is only 3,000 r. if given in 20 days, but 5,100 r. when protracted over 60 days.

The symptomatology, diagnosis, and clinical management of nasopharyngeal tumors is discussed extensively. GERHART S. SCHWARTZ, M.D.

Jensen, A.: Dose Measurements in Roentgen Irradiation of the Female Pelvis. *Acta radiol.*, Stockholm, 1945, 26: 99.

The purpose of this investigation is to compare the skin dose-tumor dose ratio as it occurs in the roentgen ray treatment of the parametria following the usual intracavitary radium treatment of uterine carcinoma, (a) if cross firing through 2, 4, or 8 portals is used, and (b) if rotation treatment is applied. In the latter case the patient lies horizontally on a stretcher while the roentgen ray tube moves around the patient.

Three principal arrangements were used for the rotation method: (1) the tube describes a half circle of 180 degrees around the long axis of the patient within several minutes; then the patient is turned

from her back onto her abdomen and the circle is repeated so that a continuous skin belt around the pelvis is exposed to roentgen rays; (2) two complete circles around the patient are described by the tube, the radiation being angulated first toward the feet of the patient, and later toward the head of the patient, which results in 2 x-ray exposed skin belts which cross each other; (3) rotation around 2 parallel long axes 12 centimeters apart. In this arrangement, only a limited sector is described by the tube around each side of the patient.

The measurements were taken on an anatomical preparation, on a paraffine-dichlorobenzol phantom, and on actual patients. Sievert ionization chambers were used on the surface and within the test objects. An intravaginal thimble chamber of a Siemens dosimeter was used on patients.

The speed of the circling tube was varied. In some experiments it was constant, and in others the tube was purposely slowed up over certain sectors.

The author found that the best dosage distribution and the optimal skin dose-depth dose ratio could be obtained in the third arrangement, and that it was superior to all arrangements of group a. This is explained by the fact that the uterus received an adequate dosage from the radium treatment alone, so that the roentgen radiation should be concentrated to either side of the uterus in the parametria. The measurements for all tested arrangements are given.

GERHART S. SCHWARZ, M.D.

Robbins, L. L., Aub, J. C., Cope, O., and Others: Superficial "Burns" of the Skin and Eyes from Scattered Cathode Rays. *Radiology*, 1946, 46: 1.

The authors' report is concerned with varying degrees of injury received by 6 men at the Massachusetts General Hospital, Boston, as a result of exposure, for a few seconds, to scattered electrons from a 1,200 kv. electrostatic generator.

The effect of exposure to cathode rays in the direct beam was known, but the effect of scattered cathode rays was not understood. Previous workers have observed clinically and experimentally that the effects of cathode and roentgen rays are similar, except that the former have a definite and limited depth of penetration involved in underlying reaction. The energy that of roentgen rays. This is readily understood when it is realized that in the production of the latter, probably only 0.5 per cent of the energy of the latter, from stream is converted into roentgen rays.

On December 1, 1944, in the supervoltage treatment room, the target had been removed from the tube of the 1,200 kv. electrostatic generator, and the cathode ray window inserted. This was necessary to correct the focal point as to size and location. The danger from the direct beam was known, but it was thought that if a reasonable distance were maintained, there could be no great danger for a short period of time. Consequently, 6 men entered the room while the machine was in operation. The machine had been running no longer than 2 minutes,

and each man stood at least from 3 to 5 feet or more away from the central beam and at right angles to it. At one point all of them leaned down, and for 5 seconds or less looked up at the cathode ray window to observe its fluorescence.

Following the accident it was realized that approximate ionization measurements should be obtained in order to estimate the dose and depth of penetration of the irradiation received by those who were in the room. The source of radiation was a vertical 1,200 kv. cathode ray beam emitted through a 0.005 cm. thick aluminum window in the tube, which was 175 cm. above the floor. It was previously known that the maximum range under these conditions is 5.4 mm. in water and probably 450 cm. in air. The beam current was estimated at about 5 microamperes. To obtain the ionization dose estimates in the tissue of those who were irradiated, measurements of the ionization intensity in a phantom were made. The Victoreen R meter gave approximately the same readings. It was estimated that those who stood 100 cm. from the cathode post for 20 seconds received a skin dose of about 1,000 r on their faces and 2,000 r. on their hands. The dosage to the feet would be greater, but this region was well protected by clothing. The measurements also show that the effects will be limited entirely to the first 3 mm. below the surface and will be greatest in the first mm. The effect of cathode rays and of roentgen rays may be similar in regions receiving the same ionization dosage; however, the distribution of energy absorption in the body from cathode rays is very different from that of roentgen rays.

The exposures to cathode rays produced burns which were analogous to but different from sunburn, thermal burns, and roentgen ray burns. The primary reaction was prompt in appearance and was like a very intense sunburn but was not followed by tanning. There were early signs of irritation to the conjunctivae. The first phase lasted from 5 to 7 days.

The secondary phase occurred in from 10 to 15 days after exposure and was characterized by pain of the face and nailbeds, followed by a second increase in redness and edema of the involved parts. The edema was limited to the skin, and in the 3 severe cases bleb formation occurred. In the 3 milder cases the pain and edema disappeared after from 5 to 7 days, and the patients suffered no further symptoms.

The 3 severe cases exhibited a tertiary phase in approximately 4 weeks after exposure. They showed new areas of involvement, appearing at varying intervals, in parts which had been protected by clothing, and these followed the same characteristics as the primary phase—some going on to pigmentation, edema, bleb formation, and even whole thickness skin destruction. Several older areas which had healed broke down for a second time. The most severe case which developed full thickness skin loss from the blebs that started in the secondary phase became more extensive and ruptured. The transudate from the wounds became purulent, and bacteria typical of normal skin flora were obtained.

penicillin proved effective in controlling this complication. Grafting was necessary to heal this skin defect.

In addition to thermal burns, there was an absence of subcutaneous edema, which suggests a superficial effect and therefore absence of damage to the capillaries. None of the lesions involved tissues deeper than the dermis.

In comparison with severe roentgen ray reactions, the cathode ray reactions became manifest much sooner and caused decidedly less pain. Their periodicity is unique. They exhibited temporary lulls during which beginning healing was evident.

The late effects are somewhat similar to roentgen ray reactions, but what the final changes may be is still unknown.

An excellent clinical description is given of the cathode ray burns and protocols, and the article is accompanied by colored photographs showing the progress of the cases. HARVEY S. ALLEN, M.D.

### RADIUM

Medical Officers of the First, Third, Eighth, Twelfth, and Fifteenth Air Forces: The Use of Radium in the Aerotitis Control Program of the Army Air Forces. *Ann. Otol. Rhinol.*, 1945, 54: 650.

The medical officers of 5 Air Forces participated in the preparation of a report on the use of radium in the Aerotitis Control Program. The organization of the program began in May, 1944 when the Air Surgeon assigned 10 otologists to the Johns Hopkins Hospital, Baltimore, to be indoctrinated, under the guidance of Samuel J. Crowe, in the problem of aerotitis and its possible control by the radium treatment of lymphoid hyperplasia about the pharyngeal ostia of the eustachian tubes. These otologists were then sent to the various Air Forces, some stationed in the United States, others operating in the theaters of war where they actually carried out the work.

The Program became necessary because of the fact that a great number of airmen had been incapacitated by the aerotitis, which interfered seriously with the efficiency of the Service. In referring to the overseas situation in the years 1943 and 1944, one Air Force Theater Surgeon stated: "In the end, these men take up a lot of time of the Unit surgeons, occupy hospital beds, and are not available for combat duty a third of the time."

The term "aero-otitis media" was coined in 1937 by Armstrong and Heim, who defined the condition as an acute or chronic traumatic inflammation of the middle ear due to improper ventilation during flight. Normally, equalization of pressure between the middle ear and the surrounding air is accomplished by swallowing, yawning, or other acts which cause the eustachian tubes to open at regular intervals. Certain predisposing factors, the most common of which is lymphatic hyperplasia in and around the pharyngeal ostia of the eustachian tubes, however, prevent such an equalization of the pressure. The result is that the eustachian tubes become completely

blocked, and cause pain, tinnitus, and deafness of varying degree and duration. This occurs especially during changes in barometric pressure associated with rapid descent. In severe cases, fluid or blood may accumulate in the tympanum and occasionally the drum may perforate.

Otoscope examination reveals retraction and congestion of the tympanic membrane, and often hemorrhage into its layers. Nasopharyngoscopic examination shows that in the majority of such cases there is evidence of excessive lymphoid hyperplasia in the fossa of Rosenmueller, in and around the pharyngeal orifice of the eustachian tube, or in the area between the tubal orifice and the posterior end of the middle turbinate.

Because of this striking correlation between the lymphoid hyperplasia and the incidence of aerotitis in the airmen, it was decided to try to destroy the lymphoid hyperplasia, not only in the men who had already developed a chronically recurring aerotitis but also, if possible, in all those in whom the location and amount of lymphoid hyperplasia would indicate a predisposition to aerotitis. The Air Surgeon authorized the use of radium as the most efficient means of destroying the lymphatic hyperplasia.

The following technique was recommended:

Two nasopharyngeal radium applicators, each containing 50 mgm. of radium sulfate, are introduced simultaneously along the floor of the nose, one on each side. The applicator consists of a radium-containing chamber and a wire handle. The chamber is made of monel, 2 cm. long, has an outside diameter of 2.3 mm., an inside diameter of 1.7 mm., and a wall thickness of 0.3 mm. The chamber is brazed to the wire handle to prevent the possibility of its being broken off and swallowed or aspirated. In the beginning the exposure was for 6.6 minutes, giving a dose of approximately 1 gm., 20 seconds. Later, the exposure was increased to 8.5 minutes, leading to a dose of 1 gm. 25 seconds. With the 0.3 mm. monel filter, the radium source emits 30 per cent beta rays and 70 per cent gamma rays. Whenever possible, 3 applications are made at intervals of from 25 to 30 days.

Treatment should not be given in the presence of an acute upper respiratory infection. In subacute infection, the dose is split into two equal fractions, given 5 days apart. Special care must be taken not to bend or break the applicator since the escape of radon would render the radium useless as a source of irradiation. It is also necessary to observe strict protective measures for the personnel giving the treatment. The best protection being distance, the treatment rooms should be at least 20 feet away from the examining rooms. The applicators must be handled as briefly as possible. To clean them, a soft brush is fastened to the sink and they are rubbed against this brush.

To secure comparable results, the Air Surgeon devised standard methods of history taking, of examination, of interpretation of findings, and of treatment.

The First Air Force was located in the United States. The program was conducted by Hendricks, Lieberman, Lyman, McMurray, Magnuson, and Weymuller. There were two Irradiation Clinics, one at Westover Field, Massachusetts, and the other at Mitchell Field, New York.

During the period from September 10, 1944 to June 1, 1945, Hendricks and Lieberman, after examining 3,525 airmen in combat crew training at Westover Field, found an incidence of 44.3 per cent of lymphoid hyperplasia in and around the eustachian tubes, which required treatment. A past history of aerotitis was two and a half times as frequent in the men who were treated as in those who were rejected for treatment. In a group of 778 airmen, it was possible to extend follow-up observations to 30 days or more after 3 treatments were given. Of these, 90 per cent showed a definite reduction in the amount of lymphoid tissue, as compared to that found at the original examination. In 54 per cent of the men there was subjective improvement. Upon completion of treatments, the incidence of aerotitis in the treated men became practically identical with that of the group who were rejected for treatment.

Weymuller and Magnuson, during the same period, treated 52 cases of recurrent aerotitis at Mitchell Field. Only 8 cases failed to respond, the most frequent causes of failure being allergy, chronic sinusitis, vasomotor rhinitis and sinusitis, and frequent colds.

The Third Air Force likewise was stationed in the United States. The program was conducted by Gleuber, Smith and Earl. There was one Irradiation Clinic established at Drew Field, Florida. In this Air Force, 1,177 flying persons were treated. In 381 cases, a good follow-up was obtained. The subjective improvement amounted to 54.4 per cent after the first treatment, and 90.5 per cent after the second treatment. Objective improvement was noted in 95.2 per cent after the second treatment. Unfortunately, no observations could be made after the third treatment but it is presumed that the final results must have been even higher. The most frequent causes of failure were grossly hypertrophied adenoids, recurrent colds and nasopharyngitis, and permanent defects either in the tympanic membrane or in the nose.

The Eighth Air Force was located in England, from where it operated over the continent. The Aerotitis Control Program was conducted by 3 medical officers, one attached to each division: Eschenbrenner, Jr. to the First, Collins to the Second, and Lyle to the Third Division.

The period of examinations and treatments was from November 1, 1944 to February 14, 1945, but some follow-up studies were continued until June 1, 1945. A total of 1,124 men with aerotitis were examined. Of these, 977 were bomber personnel and 147 were fighter pilots. Treatment was given in 404 cases and a group of 66 untreated cases were used for control. A subjective improvement was noted in 58.3 per cent of the men after the first treatment, in

77.0 per cent after the second treatment, and in 78.2 per cent after the third treatment. The corresponding objective improvement was 78.4 per cent after the second and 94.6 per cent after the third treatment. It was noted that persons with repeated groundings for aerotitis had a high incidence of air difficulty in the decompression chamber.

The Twelfth Air Force operated through Corsica, northern Italy, France, and Germany as a very highly mobile unit. The Aerotitis Control Program was entrusted to Mikell who, during a few months, had to cover with his Irradiation Clinic 20,000 miles by air and 5,000 miles by land, using every imaginable vehicle for transportation. From December 21, 1944 to April 21, 1945, Mikell examined 704 men of whom 394 received treatment. It was possible to follow up 162 men 30 days after the third treatment. The final results showed 89 per cent of subjective and 80 per cent of objective improvement.

The Aerotitis Irradiation Clinic of the Fifteenth Air Force was in charge of Trappaso, who travelled between bomb groups by jeep and trailer. From November 9, 1944 to April 21, 1945 Trappaso examined 1,580 men and treated 1,002 men. However, because of the rapid turnover of personnel, only 91 men could be followed up 30 days or more after the third treatment. The subjective improvement amounted to 44 per cent after the first, 64 per cent after the second, and 81 per cent after the third treatment, whereas the objective improvement was 76 per cent after the second, and 98 per cent after the third treatment.

A tabulation of all the available data from the five Air Forces indicates that a total of 14,345 men were examined by the participating units and 6,881 were selected for treatment. A total of 14,045 treatments were given without a single instance of burn or ulceration. The only reaction noted by a small proportion of the men was a mild stuffiness of the nose or a slight sore throat.

The final conclusion is drawn that radium, by destroying lymphoid hyperplasia in and around the pharyngeal orifices of the eustachian tubes, is of definite value in aerotitis, not only as a curative agent but also as a prophylactic measure.

T. LECUTTI, M. D.

## MISCELLANEOUS

Reynolds, L.: Newer Investigations of Radiation Effects and Their Clinical Applications; Paracost Lecture. *Am. J. Roentg.*, 1946, 55: 135.

The mechanism of the reaction which occurs when a patient is treated with a beam of radiant energy has been an intriguing problem from the earliest days of radiation therapy. A worth while theory was not advanced until 1922 when Dessauer published his "point heat hypothesis." According to this theory the absorption of radiation is discontinuous, the energy ultimately becoming concentrated in a few discrete entities within the cell. Only the energy in the form of heat liberated at these points was thought

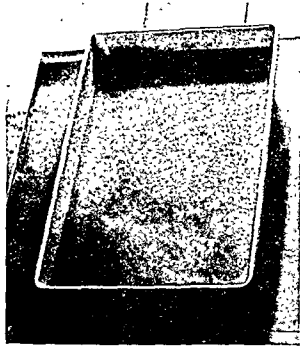


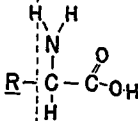
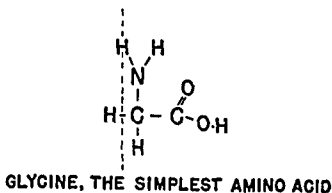
Fig. 1. This shows a monomolecular layer of lipid material prepared on the surface of water and exposed to only 600 r. of 550 kv. radiation. In this case the radiation enters through the bottom of the thin aluminum pan and passes through a 2 cm. layer of water before it hits the monolayer. In this way, the beam is brought to equilibrium with its secondary electrons. It can be seen at once that the beam, which entered through a small square portal under the pan, has imprinted itself clearly on the monolayer on top of the water.

to cause any effect. The "point theory" was modified by Crowther in 1938 and assumes that action takes place whenever a pair of ions are liberated within the sensitive target area. This phenomenon was thought to be due to a "hit" of the biological structures by the radiation. Other investigators interpret a "hit" as the absorption of a photon.

In contradistinction to this discontinuous effect a more generalized action was assumed by proponents of a second theory commonly known as the "poison theory." The poisonous material was produced by radiation of the nucleus, which then produced death or injury of the entire cell. Failla, in 1937, in his "fluid flow theory" assumes a general effect through change in the ratio of the "radio ions" and the photochemical products on the two sides of the cell membranes. This creates a change in the fluid flow which leads to alteration of the cell properties.

The author, in his experiments, directs attention to certain physicochemical reactions which may influence the equilibrium between the intracellular and extracellular medium, as well as the function of the intervening cell membrane.

The osmotic pressure of a solution of 1 per cent egg albumin was studied after irradiation with 12,000 r. at 550 kilovolts. The osmotic pressure was increased to 78 per cent and was proportional to the dosage administered. The osmometer developed by the



#### ANY $\alpha$ AMINO ACID

Fig. 2. This shows the form of some of the amino acid groups of which these large protein molecules are built. The simplest one, of course, is alpha amino acetic acid (glycine). In the chart the hydrophilous groups are to the right of the line drawn vertically through the molecular formulas. A number of very interesting things about these hydrophilous groups are immediately apparent. In the first place, every alpha amino acid has both a negative and a positive group attached to the same carbon atom on the end of a hydrocarbon chain. Some of the more complicated ones also have either a positive or a negative one elsewhere in the chain. This gives rise to the familiar peptide linkage by means of which one of these acids can join with another. When we come to consider their solubility in water and their chemical behavior, it is obvious that they will be attracted differentially by acid or basic solutions.

author is a modification of the one designed by Fazer and Myrick. Details of its construction are given. A second osmometer was built according to the plans of Bourdillon, a special membrane material of protein composition being used. The results with this instrument were the reverse of the previous findings. Upon analysis it was found that the membrane had become permeable to the breakdown products of the albumin, and the osmotic pressure had been lowered. An analogy was drawn from these results to the biological effects observed in a dog's brain after x-radiation. One part of the brain showed rather marked intracellular edema. Another part which had received larger dosage showed marked shrinking of the cells. These shrunken cells were thought to be due, not to rupture of the membrane, but to the passage of small protein fragments through the cell membrane (since the chromatin remained intracellular). In the second group of experiments a monomolecular layer of unsaturated lipid material prepared on a surface of water was irradiated with 600 r.

at 550 kilovolts. The beam was directed through a 2 centimeter layer of water. The shape of the emerging square beam can be seen imprinted on the monolayer on top of the water in Figure 1. Further experiments show that greater doses of x-rays were required to produce the same change in a more completely saturated fatty acid. In some cases the surface required ageing to bring about this effect. It has been shown by numerous investigators in the field of physical chemistry that fatty acid molecules in a monomolecular layer will orient themselves at a water-air interface, so that the carboxyl group or polar group is in the water and the hydrocarbon chain or nonpolar group stands erect in the air. In a similar fashion amino acids or proteins are also composed of polar and nonpolar groups and will orient themselves at an interface. Figure 2 is an example of the amino acids in which the hydrophilous or polar groups lie to the right of the vertical line and the hydrophobic or nonpolar groups lie to the left. These oriented monomolecular layers have definite physical properties—they resist cleavage and compression with varying degrees of strength according to their chemical and physical composition. It has been shown that lipoid substances will combine with protein monolayers. Such a combination probably represents our nearest approach to the cell membranes. These membranes are dynamic complex structures which respond to small physical and chemical changes of environment.

Lecithin, an important constituent of brain and nerve tissue, is a highly polar molecule. Multiple monolayers of lecithin (arranged like a stack of cards) exhibit strong optical properties. These optical properties are destroyed by x-radiation. An analogy is drawn between the loss of optical properties of the multilayers of lecithin and the loss of optical properties of myelin when exposed to x-radiation.

During the past several years the author has investigated the effects of x-radiation on normal dog brain. He found that myelin was comparatively radiosensitive, in contrast with the more radio-resistant brain cells. In addition, it was found that brain damage began when the myelinated nerves lost their optical properties (birefringency) even though they retained their outward physical form. The myelin degeneration which follows irradiation in dogs may require as long as one year to become evident.

Three patients presenting brain tumors who had received x-ray therapy demonstrated the same myelin sensitivity as was observed in dogs.

Thus, it is seen that structures which depend for their functional properties on a highly organized system of polar molecules lose their organized structure when bombarded with high energy radiation. The animal experiments show that when structural organization is gone, function is gone with it.

R. B. LEWIS, M.D.

## MISCELLANEOUS

### CLINICAL ENTITIES—GENERAL PHYSIOLOGICAL CONDITIONS

Harvey, V. K., and Luongo, E. P.: *Physical Capacity for Work; Principles of Industrial Physiology Related to the Evaluation of the Working Capacity of the Physically Impaired.* *Occup. M.*, 1946, 1: 1.

This report is the third in a series devoted to the United States Civil Service Commission's program for the employment of physically impaired persons.

Examination of a human being to find what work he is fit for involves knowledge of a method not yet possessed by medical science, namely, a method of estimating reserve compensation. Present techniques of measuring job requirements and physical capacities are only reasonable guides. They have value only as guides since there is a substantial margin of error both in the determination of the requirements of the job and in the physical evaluation and selective placement of the applicant. In the final analysis, regardless of what systems of job analysis and of evaluation of working capacity are used, the two most important factors in estimating physical capacity for work are the diagnostic acumen of the examining physician and his knowledge of industrial conditions.

In this connection, the future of the physically impaired in government or private industry will be as good as the type of preventive industrial medical service which management is willing to provide. The future of industrial medicine is closely allied to "human engineering" in the promotion of individual physical and mental hygiene, nutritional guidance, physical training, and the control of fatigue, as well as in the aiding of management in the selection of employees for specific types of work. In this connection, periodic re-examination of employees and jobs probably should be mandatory, especially in the case of the physically impaired.

The "must" in dealing with the applicant for work who presents an impairment, whether he is a veteran or a nonveteran, is to give him a fair chance to make good under his own power plus whatever assistance or special benefits are provided by law—state, municipal, or federal.

The general risk that an employer takes in hiring seemingly normal persons without being able to measure the large number of success factors involved in work is considerable. It may exceed any risk he takes with physically impaired persons whose capacities have been evaluated and matched with the requirements of the job. Mistakes in placing the worker with an impairment are inevitable, as in the case of the able bodied, but the failure of a person with a particular type of defect to do a particular job should not prejudice an employer against considering another person with the same defect for the same job

unless it has been definitely substantiated that there is a physiologic or a psychologic contraindication in the requirements of the job. In cases in which there is a doubt whether the remaining capacities of the person with an impaired function are adequate for successful performance of the job, the doubt should be resolved in favor of the applicant, with the understanding that if he does not prove successful in the job, he may be referred to appropriate rehabilitation authorities or reassigned, and that if this is not possible, his employment may be terminated.

WALTER H. NADLER, M.D.

Loehle, J. F.: *Oral Plasma Feeding.* *J. Pediat.*, S. Louis, 1946, 28: 145.

Many investigators have advised the incorporation of proteins, in some form or other, in neonatal and complementary feedings as the best method to remedy neonatal weight loss. Human milk is not Nature's first food substance of predilection for the human newborn infant, for the human breasts first and foremost provide colostrum. The closest available substance corresponding to colostrum is human plasma, provided the fat content be removed.

With these facts in mind, 7 premature infants were fed orally with a plasma solution in place of any other nutrient substance, and after 24 hours of this type of feeding, plasma was added to the variously constituted neonatal feedings. The object was to reduce the limitations set by employing merely one or two types of neonatal feedings.

In all cases neonatal weight loss ceased, and the infants thrived. Moreover, all of them showed appreciable weight losses when the plasma was subtracted from the feedings. These changes were more conspicuous than those observed in other types of neonatal feedings of high protein content. Intestinal disturbance was absent if the plasma when fed to the infants was free of red cells and suspicious antigens.

ERNEST E. ARNHEIM, M.D.

Slobody, L. B., Benson, R. A., and Mestern, J. J.: *The Induction of Vitamin C Subnutrition.* *J. Pediat.*, S. Louis, 1946, 28: 134.

Sixteen children ranging in age from 5 to 11 years were given from 50 to 300 mgm. of ascorbic acid daily until the skin test (based on the intradermal injection of a dye which is decolorized by Vitamin C) and the plasma ascorbic acid levels were within normal range (more than 0.2 mgm. per cent). This was usually accomplished in from 1 to 3 weeks. Then the diet, which contained no citrus fruits or tomatoes, was begun. Before the diet was started, the skin test time was 9 minutes or less in 14 children and 11 minutes in 2 children. The ascorbic acid levels in the blood ranged from approximately 0.5 to 1.9 mgm. During the diet, the skin test time became prolonged beyond 14 minutes in all of the



children. The skin test time was again shortened to normal following the administration of from 25 to 200 mgm. of ascorbic acid per day. During the diet most of the plasma levels of ascorbic acid fell. The blood levels rose following the administration of ascorbic acid.

The children felt well during the entire study and there were no abnormal physical findings. The blood counts and roentgenograms were essentially normal. In 5 cases the serum phosphatase was found to be within normal limits. Gross and some biomicroscopic examinations of the gums revealed some gingival manifestations of vitamin C deficiency, but no attempt was made to evaluate and correlate these findings.

ERNEST E. ARNHEIM, M.D.

Karelin, V. M., and Tscharnaya, D. S.: The Treatment of Internal Hemorrhages and Hemorrhagic Diatheses with Vitamin K. *Vrachebnoe Delo*, 1945, p. 11.

Palladin prepared a water soluble vitamin K<sub>3</sub> which is the sodium salt of methyl-naphthohydroquinone-sulfo acid and is only half as toxic as the alcoholic solution of vitamin K<sub>1</sub> or methyl-naphthoquinone.

The authors were able to increase the coagulability of the blood and to diminish the bleeding time in nearly all of their patients by administering one or the other of these mentioned products. Vitamin K was used in the form of an alcoholic or aqueous solution and also in the form of tablets. The drug was administered 2 or 3 times a day for 3 days in succession, each individual dose containing 10 mgm. of the active substance. If the bleeding did not stop after 3 days the treatment was continued for 3 days more.

Vitamin K<sub>3</sub> was found to be very effective in the treatment of pulmonary, gastric, and uterine hemorrhages. In patients with hemophilia the blood began to coagulate earlier than in the control experiments. In icteric patients the administration of vitamin K<sub>3</sub> was followed by a diminution of the amount of bilirubin in the blood. This observation suggests an improvement of the liver function. In patients with gastric hemorrhages, blood disappeared from the feces after the administration of vitamin K<sub>3</sub>. In 1 patient with a cancer of the stomach the blood in the feces persisted but the number of thrombocytes rose from 84,000 to 200,000. In patients with Werlhoff's disease, epistaxis and subcutaneous hemorrhages ceased after the administration of vitamin K<sub>3</sub>. In all instances the amount of prothrombin increased.

The authors conclude that vitamin K<sub>3</sub> deserves greater use for prophylactic treatment and is also indicated in the therapy of pulmonary, gastric, and uterine hemorrhages.

JOSEPH K. NARAT, M.D.

Van Vyne, A.: Prothrombinemia in Hemorrhagic Diatheses and Its Response to Vitamin K. *Rev. belge sc. med.*, 1944, 15: 173.

The different methods of determining the prothrombin level of the blood are discussed. The

author prefers the two stage method of Smith, Warner, and Brinkhous which permits a true titration of the prothrombin. Thromboplastin and calcium are added to the defibrinated plasma, which transforms the prothrombin into thrombin. To this mixture fibrinogen is added and the coagulation time taken with increasing dilutions of plasma. The highest dilution which shows coagulation within 15 seconds indicates the prothrombin level.

Large series of tests were done in human beings and animals (dog, rabbit, and chicken). The most significant results were:

1. In normal persons, the prothrombin level is very constant and hardly varies in the same individual. The same holds true for dogs. All values below 80 per cent are to be considered pathological. Hypoprothrombinemia has never been observed as a spontaneous occurrence, but may be produced experimentally by the injection of vitamin K; it is transient and followed by a short period of hypoprothrombinemia.

2. The role of the liver is a double one: (a) resorption and storage of vitamin K of exogenous or endogenous origin (therefore, a considerable decrease of the prothrombin level in biliary obstruction can be corrected promptly by vitamin K treatment) and (b) under the influence of vitamin K, the liver produces the necessary amount of prothrombin. Any damage of the liver causes hypoprothrombinemia. This responds more or less favorably to the administration of vitamin K, according to the functional condition of the liver. Thus, the response to vitamin K can serve as a test to the extent of liver damage. This was shown in cases of portal cirrhosis, icterus catarrhalis, acute hepatitis, and carcinoma. The success of blood transfusions in hemorrhagic diathesis of hepatic origin is based only on the prothrombin content of the transfused blood.

3. In anaphylactoid purpura (Henoch, Schoenlein) and in peptone shock of the dog, sudden hypoprothrombinemia occurs; this responds to vitamin K and seems to indicate a relationship between liver damage and anaphylactoid purpura.

4. The normal newborn shows a marked hypoprothrombinemia of from 25 to 30 per cent; premature infants present even less.

5. Other pathological conditions, like pernicious anemia and severe malnutrition, also reveal marked hypoprothrombinemia.

WERNER M. SOLMITZ, M.D.

Robinson, D. T., McLeod, J. W., and Downie, A. W.: Dust in Surgical Theaters as a Possible Source of Postoperative Tetanus. *Lancet*, London, 1946, 1: 152.

Tetanus following surgical operations is relatively rare, although in civilian practice almost 10 per cent of more than 3,000 cases of tetanus reviewed by Wainwright in 1926 were postoperative. It is usually impossible to prove the source of infection in these cases, although various materials have been incriminated on circumstantial evidence. Catgut has

often been blamed, and occasionally the evidence for this has been strong (Mackie, 1928). Imperfectly sterilized dressings and instruments, the skin at the operation site, and sulfonamide powders have also come under suspicion. Toxigenic tetanus bacilli have been found in human feces by various observers, although the incidence of this apparently varies in different countries and different communities, and the intestinal tract of the patient has therefore been regarded as the source of infection in abdominal or gynecological operations (Tulloch, 1919).

Tetanus bacilli are often present in soil and street dust from which wounds due to accidents may become infected. Dust in hospital wards or operating theaters has not often been seriously considered as a possible source of tetanus infection of operation wounds, but the observations made in relation to the 2 cases reported indicate that this possible source should not be overlooked.

Steps should be taken to exclude as far as possible infected dust from operating theaters. This would involve, among other measures, the wet dusting of operating theater floors and walls with antiseptic solutions, the filtering of the air coming into the theater through ventilating shafts, and precautions against the introduction of infected dust on the footwear of theater personnel. This last measure might be effected by insisting that at some point in the corridor sufficiently remote from the theater everyone entering should put on gumboots or some equivalent which had been left standing in a potent antiseptic solution. JOHN E. KIRKPATRICK, M.D.

**Bachman, A. L., and Bershon, A. L.: The Roentgenographic Appearance of Temporomandibular Hydrarthrosis. *Radiology*, 1946, 46: 251.**

The roentgenographic diagnosis of effusion into the temporomandibular joint has only rarely been reported. A comprehensive review of the literature revealed a single case record.

Effusion into the temporomandibular joint has been reported as occurring in a variety of conditions. These have been grouped as (a) traumatic arthritis, (b) rheumatoid arthritis, and (c) suppurative pyogenic arthritis.

While effusions in the temporomandibular joint have been noted as occurring in such conditions, a careful search through the literature revealed no reports other than the report of Bishop, in which the diagnosis of hydrarthrosis was made by x-rays.

A considerable similarity of symptoms exists in cases of acute hydrarthrosis and of dislocation of the temporomandibular joint. There is severe pain and tenderness in the temporomandibular region associated with marked limitation of mandibular movement in both. Roentgenographic examination appears of major importance in the differentiation between effusion and condylar luxation. The necessity for excellent roentgen demonstration of the joint in several views is therefore apparent.

The diagnosis of temporomandibular joint effusion led to conservative treatment with heat and rest, as

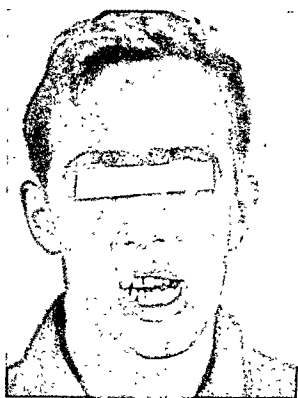


Fig. 1. Appearance of patient on admission. Note protrusion of the lower jaw forward and to the left.

in any other acute hydrarthrosis. The rapid recovery observed clinically and roentgenographically was strong evidence in substantiation of the diagnosis.

The cause of the effusion in this patient was uncertain. Two possibilities appear most worthy of consideration, the others being more or less excluded by the short course of the illness. Although the patient gave no history of any excessive movement of the jaw, the possibility exists that he may have unconsciously moved his mandible into an abnormal position during sleep. The second possibility is that the hydrarthrosis was an early manifestation of rheumatoid arthritis and that other joints may become involved at a later date.

HARRY W. FINK, M.D.

#### DUCTLESS GLANDS

**Albert, A.: The Experimental Production of Exophthalmos in the Fundulus by Means of Anterior Pituitary Extracts. *Endocrinology*, 1945, 37: 389.**

Experimental hyperthyroidism has been produced in many animals by the injection of hypophyseal extracts. Hyperthyroidism with exophthalmos could be produced in ducks, guinea pigs, and also in the fundulus, the common Atlantic "minnow."

Healthy specimens of fundulus heteroclitus, Linn., measuring from 3 to 4 inches in length were kept in a stock tank of running tap water. Impure preparations of both follicle stimulating hormone



Fig. 1. Two exophthalmic fish (left and right) 12 hours after a single injection of sheep anterior pituitary extract. Normal fish in the center for comparison.

(F.S.H.) and the luteinizing hormone (L.H.), obtained from whole pituitary glands of sheep, were injected through the cloaca into the peritoneal cavity. As early as 3 hours after a single injection, exophthalmos was noticed with a maximum demonstration on the second or third day after a single injection. The exophthalmos lasted about 2 weeks and the eye balls then reverted to normal.

Protein from other sources did not produce exophthalmos, nor did other hormonal substances including thyroid and thyroxine. Exophthalmos was produced only by a pyridine extract of sheep pituitary, by the F.S.H., L.H., and thyrotropic hormones. A rapid method of preparing the exophthalmic factor (E.F.) was devised by precipitation with ammonium sulfate, and following dialyzation and centrifuging. The resulting clear solution contained 2 gm. eq. per cubic centimeter, or about 40 E.F. units per cubic centimeter.

*Relation of the thyroid to exophthalmos.* Although it was shown that thyroid hormone did not produce exophthalmic reaction, it was of interest to determine if any changes occurred in the thyroid during exophthalmos production. Although exophthalmos was definite at 3 hours after injection, no changes in the thyroid were noticed at that time. Six hours following the injection, increased vascularity of the thyroid was noticed. Twenty-four hours after the

injection, reduction and vacuolization of the cells was noticed, vascularity was maximal, the follicular cells were taller, and the nucleus was found to be closer to the base.

*The mechanism of exophthalmos.* On histological examination, a large triangular shaped edematous mass containing a few leucocytes and lymphocytes, was found within the retrobulbar space. An increased amount of free fluid could be aspirated by puncture of the conjunctiva, following which the proptosis disappeared. The amount of this aspirated fluid was 0.05 c.c. as compared with 0.01 c.c. obtainable from the normal fundulus, and the fluid was under pressure.

If a drain was inserted into the retrobulbar space of one eye, or the dorsal half of the conjunctiva was slit so that fluid could escape, no exophthalmos developed after the injection of E.F. in this eye, while the other eye showed exophthalmos. The injection of saline solution directly into the retrobulbar space produced only transitory exophthalmos, for about 18 hours, which indicated that the orbital tissues could absorb artificially instilled retrobulbar fluid. However, if pituitary extract was injected the exophthalmos might last for more than a week, which showed a direct action on the orbital tissue. The production of exophthalmos by pituitary extract was not affected by section of the sympathetic chain, by anesthesia, or by hypophysectomy.

It is assumed that in the fundulus the pituitary principle acts directly on the orbital tissue, causing edema and cellular infiltrations of the areolar and fat tissue, as well as of the muscles and conjunctiva, and forming free retrobulbar fluid. The accumulation of fluid exerts pressure on the posterior surface of the eyeball which thrusts it out of the orbit as soon as the pressure overcomes the inward pull of the extraocular muscles. Remission of the exophthalmos in the fundulus is believed to be due to absorption of the fluid.

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# SURGERY

## GYNECOLOGY AND OBSTETRICS

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### UNUSUAL METASTATIC MANIFESTATIONS OF BREAST CARCINOMA

#### I. Metastasis to the Mandible with a Report of Five Cases

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PERTHES in 1907 wrote, "the rarest form of jaw carcinoma is the metastatic." Almost 40 years have elapsed since this observation was recorded, yet its validity has remained unchallenged. During this period roentgenology, the greatest aid in the diagnosis of osseous metastases, had its origin and development. Evidently the paucity of reported instances of metastatic involvement of the mandible cannot be ascribed to the inadequacy of diagnostic facilities during these years. As recently as 1936, Geschickter stated that "although carcinoma metastasizing to bone is a relatively common condition, the upper and lower jaw are rarely involved." It is conceivable that a metastatic focus in the mandible might remain asymptomatic and thus be overlooked, but such instances must be extremely infrequent.

Three lesions which frequently produce osseous metastases are carcinoma of the thyroid, prostate, and breast. Metastasis to the mandible from these primary sites, however, appears to be uncommon in thyroid carcinoma and extremely infrequent in breast and prostatic cancer. Rare examples of metastasis to the mandible from carcinoma of the lung, rectum and kidney have been reported (Stern and Shepard, Blum). Some authors (Ehrhardt, Blumer) have described a number of cases of

<sup>1</sup>From the Breast Service of the Memorial Hospital, New York.

metastasis of thyroid carcinoma to the mandible, but we have been able to find only 11 recorded instances of metastatic involvement of the mandible from carcinoma of the breast. To this number we add 5 of our own.

The earliest recorded case is that of Batzaroff who in 1829 described the occurrence of metastasis to the mandible 21 months after a mastectomy for mammary carcinoma. There was no evidence of local recurrence. There is no other reported example until 1909 when Schlesinger published reports of 5 cases of lower jaw metastatic lesions, 4 associated with carcinoma of the breast, and 1 with carcinoma of the prostate. About 20 years later, Blair, Brown, and Womack wrote that they had noted metastatic carcinoma of the jaw three times, once from the rectum and twice from the breast. No details were given.

In 1930 Sonntag described the case of a 65 year old woman who consulted him because of a swelling of the left lower jaw of several months' duration. She had undergone a left radical mastectomy 3 years previously. There was no evidence of metastasis elsewhere, therefore the mass in the mandible was considered a primary tumor and the jaw was resected. Microscopic examination revealed the jaw lesion to be metastatic mammary cancer. The patient died one year later. Skillen also in 1930 reported the case of a 40 year old

woman with a metastatic lesion to the mandible, proved histologically, from a breast carcinoma.

The same year (1930) Thoma, in his textbook gave an abstract of 2 cases. One, a 46 year old woman, developed a metastatic lesion in the left mandible following a mastectomy for colloid carcinoma of the left breast. The second patient developed a metastasis to the left mandible from an adenosarcoma of the left breast. It is of interest that Rogers and Flo have reported a case of metastasis to the mandible consequent upon a breast fibrosarcoma.

The most recent example published is by Burket in 1941. This was a 38 year old woman who developed metastatic disease in the right mandible 4 years after a left radical mastectomy for carcinoma.

Our 5 cases are as follows.

**CASE 1.** B.E., a 41 year old female, underwent pre-operative irradiation and a right radical mastectomy 3 years before coming to the clinic. The pathological diagnosis was adenocarcinoma grade 3 with node metastasis. One year following the mastectomy the patient had an extraction of a left lower molar with subsequent numbness of the lower left side of the face and swelling of the left mandible. These symptoms persisted. Her chief complaints on admission were cough, dyspnea, pain in the chest and back, anorexia and occasional vomiting, and swelling of the left mandible.

Examination revealed a well healed right radical mastectomy scar. There was no evidence of local recurrence and no adenopathy. In the horizontal ramus of the left mandible near the junction of the middle and posterior thirds there was a smooth, hard, fixed, painless, nonulcerated mass about 2 centimeters in diameter, involving the whole thickness of the bone.

Roentgen studies disclosed evidence of metastasis to the pelvis and extensive destruction of the horizontal ramus of the left mandible (Fig. 1). An aspiration biopsy of the mass on the mandible was reported as metastatic carcinoma consistent with mammary origin. The patient was given a small amount of roentgen therapy to mandible but died of metastases about 4 months after her initial visit.

**CASE 2.** J.C., a 63 year old woman, consulted the clinic because of a lump of 18 months' duration in the right breast. The lump had been growing slowly until 2 months previously when it began to ulcerate. Examination revealed the right nipple and areola to be completely replaced by a hornifying crust and the central portion of the breast to be entirely filled by a stony hard tumor mass 6 centimeters in diameter. There was no palpable adenopathy.

The patient refused operative therapy and failed to return to the clinic for 2 years. Despite the elapsed time the condition was still operable although nodes were now palpable in the right axilla. A radical mastectomy was performed following which she made a good recovery. An area on the anterior right chest wall required a skin graft.

The pathological report on the surgical specimen was infiltrating duct carcinoma grade 3, with metastasis to the axillary lymph nodes. Because the grafted area was slow to heal the patient did not receive any postoperative x-ray therapy.

Her return visits to the clinic were irregular at first and then ceased for about 9 months. She then consulted the clinic because of the appearance of some nodules in the skin of the right chest wall at the edge of the previous graft. A biopsy of one of these nodules was reported as recurrent carcinoma and radiation therapy was advised. She failed to return for 8 months at which time low voltage irradiation was administered to the right anterior chest wall.

Another 4 months' period of absenteeism from the clinic followed. At the end of this interval the patient returned because of an enlargement in the right mandible and right temporal region. Examination revealed a hard swelling involving the right mandible. A roentgenogram disclosed numerous and extensive areas of bone destruction in the right mandible and skull which were interpreted as carcinoma metastases (Fig. 2). She received a small amount of x-ray therapy to the right side of the face but failed to return for further treatment and was lost to follow-up.

**CASE 3.** M.R., a 43 year old woman, underwent a radical mastectomy for carcinoma of the left breast in January, 1940. The pathological diagnosis was infiltrating duct carcinoma grade 3 with metastasis to multiple axillary nodes.

The patient remained free from apparent disease for about 2½ years. Then she developed a mass over the left third rib about 2 centimeters from the lateral border of the sternum. A roentgenogram disclosed an area of destruction in the anterior part of the third left rib. There was no other evidence of disease.

In view of the desperate situation the involved area of the rib was resected and at the same time the patient was sterilized, a panhysterectomy being performed. The pathological report on the excised tumor of the rib was "mammary carcinoma invading rib."

For about 1 year following this she was apparently free of disease. A roentgenogram of the chest at the end of this period failed to reveal any evidence of disease. A short time later, however, the patient developed paresthesia ("sensation of pins and needles") in the left side of her face. She considered the condition a neuralgia and treated herself. The paresthesia changed in character and became a sensation of numbness over the left lower jaw.

Several months later the patient developed pain in the lower dorsal region and a lump in the left lower



Fig. 1. Roentgenogram, Case 1, showing extensive destruction of the horizontal ramus of the left mandible.

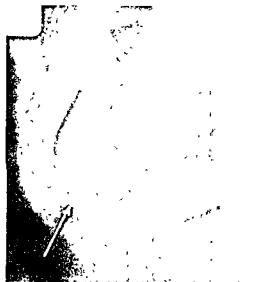


Fig. 2. Case 2. Numerous and extensive areas of bone destruction in right mandible and skull are shown.

jaw. The sensation of numbness over the left mandible still persisted. An x-ray examination of the lumbar spine and pelvis revealed numerous areas of metastasis. Roentgenographic study of the mandible disclosed an area of destruction in the horizontal ramus (Fig. 3). There were also at this time metastatic deposits in the scalp and in the skin of the chest wall. She received x-ray therapy to all of the metastatic lesions and is still living with active disease 5 years after her radical mastectomy.

CASE 4. E.M. was a 51 year old woman who in 1936 underwent a simple mastectomy for carcinoma of the left breast at another institution. She was apparently free of disease for about 2 years. Then a swelling appeared over the angle of the right mandible for which she consulted this clinic. Roentgeno-

graphic studies revealed a large area of bone destruction in the ascending ramus of the right mandible (Fig. 4). The roentgenologist believed that it presented more of the features of a primary bone tumor such as an adamantinoma rather than those of metastatic carcinoma. The irregularities of bone destruction, and the somewhat honeycomb appearance, made a diagnosis of a primary bone tumor such as an adamantinoma seem more likely. Films of the chest failed to reveal evidence of a primary tumor or metastases. Roentgenograms of the pelvis, spine, legs and arms exhibited no evidence of bone destruction or carcinoma metastasis.

An aspiration biopsy of the mass in the mandible was performed and reported as adenocarcinoma consistent with mammary origin. A submitted slide of



Fig. 3. Case 3. An area of destruction in horizontal ramus is shown.



Fig. 4. Case 4. Roentgenogram reveals a large area of bone destruction in ascending ramus of the right mandible.



Fig. 5. Case 4. Four months later roentgenogram reveals considerable bone regeneration in the area of destruction about the angle of the mandible

the original breast tumor was reported as infiltrating duct carcinoma grade 3, and this material was considered by Dr. Fred Stewart as perfectly consistent with that obtained from the mandible by aspiration.

The patient received x-ray therapy to the metastatic lesion in the mandible with considerable regression of the mass. A roentgenogram taken 4 months later revealed evidence of considerable bone regeneration in the area of destruction about the angle of the mandible (Fig. 5). Physical examination 2 years after this film was made revealed the right mandible to be slightly larger than the left near the angle.

Soon after this the patient developed anorexia, flatulence, and generalized abdominal pain. On examination a mass was found in the epigastrium. There was no other demonstrable evidence of disease. The patient's condition gradually deteriorated and she died in 1942, 6 years after the removal of the breast for carcinoma. An autopsy revealed metastatic adenocarcinoma in the liver, mediastinal, and peripancreatic lymph nodes. The metastatic cancer was reported as consistent with a mammary origin.

**CASE 5.** M.P., a 50 year old woman, consulted the clinic in June, 1943, because of a lump in the left breast of 3 years' duration and because of irregular menstrual periods of 9 months' duration. Examination revealed the right breast to be elevated, the nipple retracted, and ulceration at the junction of the nipple with the areola. Beneath the areola was a hard, nodular 2 by 3 centimeter mass attached to the overlying skin. A hard mass was palpable in the right axilla. Pelvic examination disclosed a mass posterior to the cervix which was thought to be an ovarian tumor.

An aspiration biopsy of the breast mass revealed carcinoma; therefore a radical mastectomy was performed. The pathological diagnosis was infiltrating

duct carcinoma grade 3 metastatic to the axillary lymph nodes at all levels. She received a cycle of postoperative x-ray therapy.

Upon the completion of the x-ray therapy a diagnostic curettage was done. The pathological report was adenoma malignum grade 2. The patient then received intrauterine radium therapy. Later a supracervical hysterectomy and bilateral oophorectomy were performed. The pathological report was corpus adenocarcinoma grade 2 and malignant endosalpingioma of the left ovary.

Following all of these procedures the patient remained in apparent good health for about 1 year. Then she began to have pain in the lumbar spine which upon roentgenographic studies was found to be in consequence of metastasis to the lumbar spine and pelvis. She received high voltage irradiation to these areas with amelioration of her pain.

About 5 months later she began to complain of pain in the knees. X-ray studies disclosed changes in the tibiae and lower left femur which were thought to resemble Paget's disease. For confirmatory evidence an x-ray plate of the skull was taken which revealed evidence of the presence of extensive diffuse destruction. This was interpreted as carcinoma metastasis. Blood chemical studies gave results which were consistent with bone metastasis but not with Paget's disease. The patient received x-ray therapy to the knees with subsidence of the pain.

Three months after this episode she began to experience pain in the right mandible. Examination of this area disclosed a small, swollen, tender area over the horizontal ramus. A roentgenogram of the right mandible revealed a large irregular area of bone destruction in the anterior half of the horizontal ramus (Fig. 6). The mandible was irradiated and the pain subsided.



Fig. 6. Case 5. Roentgenogram reveals a large irregular area of bone destruction in the anterior half of the horizontal ramus of the right mandible

The lesion in the mandible could have been metastatic from any of the 3 primary lesions but on the basis of probability it most likely was secondary to that in the breast.

The first indication of metastatic disease of the mandible may be pain, frequently in association with a loose tooth. In these instances the patient is usually seen first by the dentist and the tooth extracted as in the case reported by Burket and in our own Case 1. It is only later that the underlying cause is recognized. Paresthesia on occasion may be an early sign of metastatic invasion of the mandible. This is exemplified by our Cases 1 and 3. Pressure on, or involvement of, the mandibular nerve by the disease produces pain or numbness which stops sharply at the mid-point of the symphysis menti.

In some instances paresthesia of the side of the face and of the buccal and gingival mucous membrane may persist for a long period of time without any evidence of involvement of the mandible. This phenomenon is illustrated by the following case.

E.F. was a 43 year old woman who underwent a right radical mastectomy followed by x-ray therapy for carcinoma 3 years before consulting this clinic. Examination revealed no evidence of disease. During the ensuing 18 months she developed metastatic nodules in the right chest wall and nodes in the left axilla. About the end of this period she began to experience a sensation of numbness in the skin of the lower right face over the mandible and in the corresponding buccal and gingival mucous membranes. This area of paresthesia was sharply delimited at its medial aspect by the symphysis menti. Roentgenographic studies of the skull, mandible, lumbar spine, pelvis, and chest failed to reveal any evidence of metastasis. Six months later the paresthesia was unchanged and repeat x-ray studies of the skull and mandible failed to reveal any changes. The patient lived 7 months longer and during this period the paresthesia persisted without any external evidence of mandibular involvement.

In some instances in which a single metastasis localizes in the mandible a number of years after a mastectomy for carcinoma, the true nature of the condition may be overlooked and a diagnosis made of primary mandibular neoplasm. This happened in Sonntag's patient, and the mandible was resected. In our Case 4 a primary malignant lesion of the mandible was suspected. There were no other foci of disease and the roentgenographic

appearance was suggestive of a primary neoplasm. This would indicate that the roentgenogram may not always solve this type of diagnostic problem. In this connection New and Figi state that it is impossible to distinguish roentgenologically many of the primary tumors of the jaw from the metastatic malignant tumors. In some instances, however, aspiration biopsy may be of value, as in our Cases 1 and 4. By this procedure it may be possible to spare the patient a useless operation.

An interesting and perplexing problem is presented as a consequence of the finding that carcinoma of the breast manifests a predilection for certain osseous metastatic sites whereas other localities are relatively immune. Paget about 50 years ago commented on this saying "The evidence seems to me irresistible that in cancer of the breast the bones suffer in a special way which cannot be explained by the theory of embolism alone. Some bones suffer more than others; the disease has its seats of election." The theories of metastatic spread attempt to explain this phenomenon. A few of the more important theories will be briefly reviewed in an endeavor to elucidate an explanation for the infrequent involvement of the mandible.

Von Recklinghausen in 1891 was one of the first to suggest that malignant tumors metastasize to bone by means of the blood stream. According to this theory the tumor emboli become lodged in the marrow and develop a metastatic focus. His conclusion was based on the following observations: (1) Osseous metastatic lesions occur in the medullary cavity and reach the periosteum by direct extension. (2) If there is subperiosteal involvement it is always in the region of the large foramina which serve as an exit for the veins. (3) The cancer cells are found in definite channels within the marrow which he believed to be venous rather than lymphatic. It is suggestive that in 4 of the present series the lesion appeared in the horizontal ramus and in the fifth, the angle of the mandible was involved. This might be explained on the basis that hematogenous cancer emboli enter the medullary cavity through the mandibular foramen.

Handley advanced the theory that cancer is disseminated to bone by permeation through



the lymphatics. He believed that the bones nearest the breast, namely, the ribs and sternum were involved by direct extension but that the more distant ones were invaded by permeation of the cancer cells through the deep fascial lymphatics. Invasion of the bones took place at those points where they approached the skin and were consequently nearest the deep fascia. In the femur this was at the site of the great trochanter and in the humerus at the site of the deltoid insertion.

He explained the rarity of metastases to the forearm, hand, leg, and foot on the basis that lymphatic permeation was in general a slow process and that the patient died before it extended as far as the bones of the extremities. This explanation does not account for the infrequency of metastatic involvement of the mandible because the skull, which is further distant from the primary lesion than the mandible, is not infrequently the site of metastatic disease.

Carnett and Howell, while agreeing in essence with Handley's theory have advanced some important modifications. They believe that the humerus is invaded in most instances by direct permeation of the disease from the axillary lymph nodes which have become cancerous by lymphatic emboli rather than by permeation along the deep fascia of the chest wall. According to their conception the metastases localize initially in the head of the humerus and glenoid process of the scapula rather than at the deltoid insertion as suggested by Handley. The cervical vertebrae and skull are involved by a process of permeation and embolism extending from the axillary lymphatics along the infraclavicular and supraclavicular lymphatics beneath the deep fascia. The lumbar vertebrae and pelvis are involved by direct extension from the retroperitoneal lymph nodes which have become cancerous by permeation from the breast along the periaortic lymphatics. The invasion of the femur is by direct extension to the femoral head from the pelvis through the lymphatics of the ligamentum teres.

In recent years Batson has demonstrated that it is possible for material injected into the peripheral venous circulation to reach the

spine, pelvis, and skull by way of the vertebral veins without passing through the lungs. This may be the pathway in some instances of metastatic spread.

It is well established that the skull is a common site of metastasis in breast carcinoma. Carnett and Howell in their series of 101 cases of osseous metastasis from breast carcinoma found the skull involved in 14 cases but mentioned no instance of mandibular involvement. Lenz and Fried in an analysis of 81 cases encountered skull involvement in 35 per cent and no instance of mandibular disease. If involvement of contiguous bones is by direct spread, as Carnett and Howell maintain, citing as an example invasion of the head of the femur from disease of the pelvis, then the mandible ought to be involved more frequently by direct extension from the skull. Furthermore if involvement of the mandible is by direct spread from the skull it would be logical to expect the region of the condyles to be invaded early. It appears, however, that when metastatic invasion of the mandible does occur it may be in the horizontal rather than in the ascending ramus. This was demonstrated by 4 of our cases.

An interesting theory has been suggested by Pinney. He believes that bone metastases are produced by blood borne emboli which lodge in the thin walled blood channels of the red marrow, and he has been able to demonstrate plugs of epithelial cells in this location. He was unable to demonstrate any lymphatics in bone marrow and concluded that they are absent. He postulates that not only must the cancer emboli reach the marrow but the current here must be slow enough to allow the cells to lodge and grow. These conditions are satisfied by the red marrow which, because of its great vascularity, produces a widening of the blood stream bed with a consequent slowing of the current.

The localization of bone metastases is explained by this theory on the basis of red bone marrow distribution. In the infant all the bones contain red marrow but by the time adult life has been reached this has been replaced by fat except in the skull, sternum, ribs, clavicles, scapulae, vertebrae, os innominatum, and the proximal portions of the ex-

tremities where red marrow continues to persist throughout life (Doan).

Pinney ascribes the infrequency of metastasis below the elbow and knee to the absence of red marrow in these locations. He believes that bone metastasis may occur occasionally by way of the lymphatics but that the principal route is hematogenous. It is probable that both lymphogenous and hematogenous routes are essential to bone metastasis.

Some investigative work carried out by Box is of interest in this connection. He examined numerous areas of a series of human jaws and in 75 per cent found only yellow marrow. In the remainder there were small, discrete areas of red marrow encountered. From his researches he concluded that even in early adult life the bone marrow in the average normal jaw is of the fatty or yellowish variety. In those instances in which small patches of red marrow were found he believed it was due to: (1) vestiges of original red marrow that had not undergone change; (2) local stimuli such as trauma from a tooth extraction, root canal filling, or gingival infection.

This infrequency of the presence of red marrow in the mandible might, on the basis of Pinney's theory, account for the rarity of metastasis to the mandible in breast carcinoma. The only contradictory evidence is furnished by Ehrhardt's report of 65 cases of malignant struma with bone metastases, 30 of which were to the mandible. This percentage is so high that it suggests the possibility that many of these were due to direct extension rather than metastasis.

# SUMMARY

1. Eleven examples of metastasis to the mandible from breast carcinoma were found reported in the literature.

2. Five cases observed in this clinic are presented.

3. Various theories of metastatic spread are briefly reviewed in an attempt to explain the apparent immunity of the mandible to metastasis.

4. The explanation is advanced that the mandible is infrequently involved by metastatic disease because of the customary absence of red marrow.

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# THE PELVIC FLOOR IN PARTURITION

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THE orderly sequence of changes in the structure of the pelvic floor during parturition has received little or inadequate attention in recent publications. A consecutive account of what happens in the constituent structures of the floor during parturition seems opportune. While textbooks are spotty in their description of the structural anatomy, there is a manifest lack of consecutive description in the anatomical sequence of events, and particularly of the admirable structural adaptations for this natural event.

The enquiring senior students, after study and mature reflection, frequently ask: What happens to the much heralded fascial structures during delivery? How does the levator ani muscular diaphragm dilate? What becomes of the double leafed fascial structure, the urogenital diaphragm? How does it open up when the fetal head passes through it?

Briefly, at the moment of expulsion of the fetal head, the pelvic floor and the urogenital tract are converted into one continuous cleft (Figs. 1, 2, 14). At this moment, the lateral ligaments of the cervix uteri (Mackenrodt) are flattened in transverse, and elongated in vertical, section. The levator ani muscular diaphragm is funnelled. The urogenital diaphragm, or as it is more popularly known, "the triangular ligament," is opened up and closes again (Figs. 1 to 3, 5, 6, 10, 13 to 15). The smooth muscle diaphragm in the base of the broad ligament and the sphincteric group of muscles at the vulval outlet are dilated spherically. The latter are converted into a short muscular tube with the passage of the fetal ovoid.

Before these questions are answered in detail, and in order to avoid speculation, a brief anatomical preview of the pelvic floor is necessary.

From the Department of Anatomy, McGill University, and the Departments of Gynecology and Obstetrics, St. Mary's Hospital, Montreal. This work was partially assisted by a grant from the Cooper Fund of McGill University.

The pelvic floor is a musculofascial diaphragm. Extending into it posteriorly is a movable bony platform, the coccyx.

This musculofascial diaphragm is a composite structure of connective tissue, voluntary and smooth muscle and elastic tissue, arranged in five diaphragmatic layers, superimposed and interwoven one upon the other for reciprocal support. Neither singly nor united do these diaphragms form a complete sling or hammock across the pelvic floor, as they are perforated centrally by three tubular structures, the urethra, the vagina, and the anal canal. These canals are arranged very much like tubes passing through the shutters of a venetian blind. Their tubular openings are closed by the sphincteric arrangement of these musculofascial floors.

These diaphragms not only close the tubular openings, but serve as essential supports to the pelvic viscera; the endopelvic fascial and levator ani muscular diaphragms being the most essential. All five diaphragms have an anchorage into the perineal body. They are set at different planes (Fig. 3) and are fixed at different levels to the bony canal, which latter resembles the "elbow of a stovepipe." They act as so many floors of support to the viscera—placed like shingles—one gliding over the other in fluid movement, arranged that they may be dilated to their capacity as they are in parturition during the conversion of the pelvic floor into one large hiatus previous to expulsion. Dilatation of these floors occurs from above downward, and restoration comes about in the reverse order following delivery, provided their anatomical integrity has been maintained.

Trauma from childbirth is the principal cause of injury to the pelvic floor. Other causes may be congenital weakness, involution and atrophy of fat in old age, neurogenic injury to the fourth sacral nerve (spina bifida).

Following injury to any single or complete set of "uterine supports," prolapse may re-

sult. This prolapse may be complete or incomplete, as cystocele, where the anterior segment is injured, or rectocele with injury to the posterior segment, or sacropubic hernia, i.e., procidentia uteri, where anterior lateral and posterior segments are injured.

From above downward in anatomical order these diaphragms are as follows: (1) the endopelvic fascial diaphragm or upper pelvic fascial floor, (2) the smooth muscle diaphragm in the base of the broad ligament, (3) the levator ani muscular diaphragm, (4) the urogenital diaphragm, and (5) the sphincteric group at the vulval outlet.

While these composite structures differ in their development and in their function, nevertheless, collectively they are unique in their synchronous uniformity in response to functional demands. Their collective structural arrangement allows for marked excursions of distention and contractility.

Connective tissue is primarily a supportive structure in character. Fascia, in itself, is not unusually found in regions subjected to intermittent and varying degrees of tension. Usually it is most developed where it can respond as a passive elastic agent which must not be extended beyond its quantum of elasticity. Smooth or striated muscle, however, having the property of maintaining "tension" or "tonus" can withstand tension or stretching, which could not be tolerated by mere fascia. If, however, owing to nutritional or mechanical factors, its power of maintaining a high tonus is lessened, then it is a much less efficient supporting structure than is fascia. Smooth muscle has the property of maintaining, within fairly narrow limits, the same tonic force irrespective of the degree of stretch to which it is subjected until the limit of its elasticity is reached. From then on it behaves as an inactive fascial tissue. These considerations, when applied to the arrangements of the above tissues, are of fundamental importance. Smooth muscle tissue is found precisely in those regions where it is necessary to permit considerable dilatation, contraction, or movement of organs, meanwhile maintaining some degree of control of the movements of these organs independently and in relation to each other.

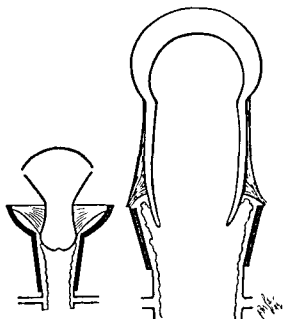


Fig. 1. Schematic representation. a, left, Structures at rest; b, uterovaginal canal converted into urogenital hiatus.

It is obvious that it is necessary to have a mechanism to restore the normal state after a major dilatation, etc., of one or more of the organs. It is equally obvious that fascia would be ineffective in such contingencies.

Dilatation of the connective tissue diaphragm, to the extent of permitting the passage of the fetal head, demands a great stretching of this poorly contractile tissue, which of itself could not assume its original dimensions as it contains little, if any, elastic tissue. Hence Nature has interposed a smooth muscle diaphragm between the endopelvic fascia and the levator ani muscle. Loss of elastic recoil and diminished sphincteric action are supplied by the presence of interwoven elastic tissue and smooth muscle fibers. The return to the normal postpartum state is assisted by the closely associated smooth muscle diaphragm which has the power of great extensibility. The fibromuscular diaphragm is not necessarily injured in normal childbirth. Dilatation of the uterus and cervical canal will slacken the tautness of the fibromuscular diaphragm, while return to the normal size of this viscus will renew the tension of the musculo-fascial diaphragm. By shifting of tissues and interplay of structures, marked excursion of dilatation and return to normal measures can take place in these associated diaphragms. These structural features are of great impor-

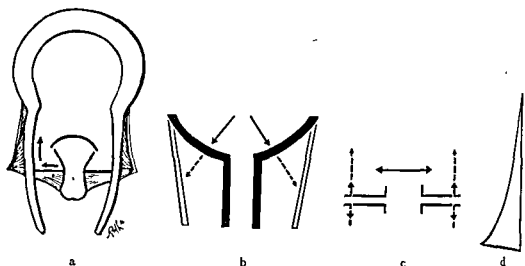


Fig. 2<sup>1</sup>. a, Center, structures at rest. Peripherally-L.U.S. stretched, vertically. L.L.C.U. stretched vertically, flattened peripherally. b, Oblique plane of L.A.M.D. converted into vertical one. c, Opening of U.G.D. indicated by arrows. d, Vertical stretching and peripheral flattening of L.L.C.U.

tance in the struggle for adaptability of spatial relationships that prevail between mother and child during parturition.

#### THE ENDOPELVIC FASCIAL DIAPHRAGM OR UPPER PELVIC FLOOR

If we look at a human embryo at about the 25th day, we find that the lower end of the abdomen is filled with a loose connective tissue through which the hind gut is passing dorsally and the allantois ventrally, these two structures meeting caudally in the cloaca. The coelom or the body cavity extends caudally for a short distance between the rectum and the allantois in front. Between the lower ectodermal wall of the abdominal cavity and the coelom is the subperitoneal pelvic space. In the embryo, this subperitoneal pelvic space is loosely packed with "embryonal connective tissue" and surrounds the as yet undifferentiated viscera. It really represents the as yet unseparated somatopleure and splanchnopleure, the body cavity not having yet extended into this region to make a clear division between these two tissues. This tissue of course arises from the mesoderm and more especially from the mesenchyme of the middle germ layer.

In a 2 months' fetus (Fig. 4-31 mm. C.R.L.) a definite central condensation of mesoderm

<sup>1</sup>Abbreviations throughout mean: L.L.C.U., lateral ligaments of the cervix uteri; L.A.M.D., levator ani muscular diaphragm; U.G.D., urogenital diaphragm; F.S., frontal section; U.S.F., uterosacral fibers; C.R., cervicorectal fibers; D., decussation fibers; B.L., broad ligament fibers; C.V., cervicovesical fibers; C.P., cervicopubic fibers.

spans the fetal pelvis transversely enmeshing the lower third of the descending müllerian ducts. Their caudal extremity is thereby pulled caudally and medially, thus helping in their junction. This transverse mesodermal condensation is known as the "transverse mesodermal bar" by Fraser. In transverse section it can be seen to fan out into anterior, lateral, and posterior segments. In frontal section, it sends a caudal prolongation dividing the allantois from the rectum; thus separating the cloaca into the urogenital sinus anteriorly and the rectum posteriorly. This descending fascial prolongation terminates in the perineal body. At this stage, it is known as the urorectal septum. The anterior coronal segment is the anlagen of the cervicovesical fascia; the lateral condensation, the lateral ligaments of the cervix uteri (Mackenrodt); the posterior projection, the uterosacral ligaments; the caudal projection the rectovaginal septum. Thus the "transverse mesodermal bar" is the anlagen of the upper pelvic fascial floor.

In an eight month fetus the lateral ligaments of the cervix uteri (Mackenrodt) fuse with, and cover, the perimesium of the levator ani muscle and attaches solidly to the lateral vaginal walls.

In an adult multipara the endopelvic fascia reaches its greatest functional development, spanning the pelvis like a hammock, trans-

versely from levator ani white line to levator ani white line, and anteroposteriorly from the symphysis pubis to the 2nd and 3rd sacral vertebrae, interrupted centrally by the urethra, cervix and vagina, and the rectum, the supravaginal cervix being the central pivotal attachment. A definite fascial fibrous capsule is present attached to the anterolateral and posterior supravaginal cervix (Fig. 5). This capsule is so arranged as to correspond to the functional demands of parturition and to the prerequisites of gynecology.

The physiological response to functional demands is greatest in parturition. Synchronously with the unfolding of the lower uterine segment a corresponding hypertrophy and hyperplasia of the endopelvic fascial structures takes place.

In the adult female topographically in coronal section the endopelvic fascia forms a diaphragm divided into anterior, lateral, and posterior segments. The anterior segment represents a platform situated beneath the bladder. Its fibers extend from the supravaginal fascial collar anteriorly to the symphysis pubis and to the anterior part of the levator ani white line. The lateral segment or condensation is known as the lateral ligament of the cervix uteri (Mackenrodt) and extends from the lateral margin of the supravaginal fascial collar to the levator ani white line. This is a well defined fascial ligamentous connective tissue capsule in the form of an inverted U (Fig. 6). It is attached to the anterior, superior, and posterior marginal walls of the supravaginal cervix. Laterally and inferiorly, this capsule is attached to the levator ani white line and to the levator ani fascia. It has anterior, superior, and posterior surfaces.

The superior surface presents large veins on its posterior aspect, while anteriorly the uterine artery is an individual entity, coursing above the fascial surface and marking the line of cleavage between this surface and the vesical fascia. Toward the lateral aspect, a reef of fascia extends obliquely from the posterior to the anterior leaf of the broad ligament above the capsule, deflecting the ureter in its lateral position.

At the extreme lateral aspect of this surface, the uterine artery crosses the ureter at a right

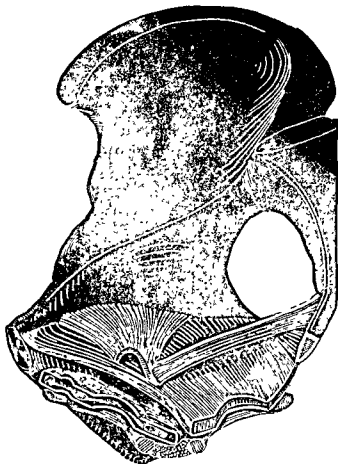


Fig. 3. Schematic representation of the various structures forming the pelvic floor. The lateral and posterior cervical ligaments L.L.C.U. (Mackenrodt), U.S.L., levator ani muscle, urogenital diaphragm, sphincter group.

angle. The ureter traverses the anterior margin of the surface in a preformed fascial groove (Figs. 5, 6, 7).

The anterior surface is the smallest of the three surfaces, because the levator ani muscle rises sharply in this region. The upper part of this surface fuses with the uterovaginal fascia giving the latter a wider "fixation span," while the lower part is attached to the fascia of the lateral vaginal wall. Caudally and laterally this surface is attached to the levator ani fascia.

The posterior surface is the largest of the three surface areas. It blends with the levator ani fascia. A foramen or gap is present between the ligament and the fascial fibers passing up from the levator to the vaginal fascia. A triangular space exists between the three surfaces (Figs. 3, 5, 6). The base of the triangular space faces caudally and laterally, being formed by the cranial fascia of the levator ani muscle.

In the normal adult this cavity contains areolar tissue and unstriated muscle. Smooth muscle fibers extending from the upper third of the vaginal wall are attached to the inferior aspect of the superior and posterior surfaces of the ligament (Fig. 8).

The posterior segment is the largest of the three areas, and its fascia the most attenuated because of the passage of the rectum. The most condensed fibers extend from the posterior inferior aspect of the supravaginal fascial collar, and terminate in the second and third sacral vertebrae. These fibers are known as the uterosacral ligaments. That space behind the cervix, bounded by the uterosacral ligaments laterally and the rectum posteriorly is known as the pouch of Douglas (Fig. 5). This is the bottom of the abdominal cavity; here the fascial diaphragm is thinnest. In frontal section, descending caudally from the posterior margin of the supravaginal collar is a tongue-like reef of fascia extending between the posterior vaginal wall and the anterior rectal wall and terminating in the perineal body. This caudal prolongation is known as the rectovaginal septum.

#### THE SMOOTH MUSCLE DIAPIHRAGM

During the last 3 months of fetal life, smooth muscle tissue exists in definite masses in the subperitoneal pelvic space. The arrangement of the tissue is identical with that in the adult, except that it is much less massive and the direction of the bands varies because of the difference between the positions of the pelvic organs in fetal and adult life. The smooth muscle tissue is not confined only to the areas immediately surrounding blood vessels and nerves. Most of it is made up of strands entirely independent of these structures. When they are reconstructed and viewed from the superior aspect, the direction of the fibers leads one to consider the tissue as an imperfect "diaphragm" of smooth muscle converging on the uterine cervix.

In the adult an imperfect smooth muscle diaphragm is present and embedded in fibrous tissue, lying between the endopelvic fascial diaphragm and the superior surface of the levator ani muscle. The smooth muscle bundles which constitute this diaphragm radiate

from the uterus at the level of the internal os. The peripheral attachment of these bundles enables the tissue to be divided into three groups of fibers, anterior, lateral, and posterior groups.

The anterior fibers arise from the anterior and the anterolateral aspect of the cervix and are attached (a) to the posterior aspect of the os pubis, either directly or through the intermediary of fibrous bands, and (b) into the muscular coat of the bladder. The muscle fibers which make up this group can be subdivided into the following bundles: (a) the cervicovesical, (b) the cervicopubic, (c) the vesicovaginal, and (d) cervicovaginal (Fig. 9).

*The lateral group* The lateral group (which is identical with the lateral ligament of the cervix uteri—Mackenrodt) arises similarly from the lateral aspect of the cervix. They diverge and form a flattened fan of fibers which is attached by means of fibrous strands to the "arcus tendineus." This group is subdivided into an upper and lower bundle. From this group, slightly below level of internal os, fibers pass to the lateral vaginal fornix.

*The posterior group* The posterior group, also arising from the cervix, enters into the composition of the uterosacral ligaments or finds insertion into the rectal walls and rectovaginal septum. This group is subdivided as follows: (a) uterosacral fibers, (b) rectal fibers, (c) posterior vaginal fornix fibers, and (d) rectovaginal septum fibers.

Besides these distinctive strands enumerated, short fibers, like a fine platysma muscle, enter the anterior and posterior peritoneal layers of the broad ligament, from the corresponding uterine surfaces and end deep in the endothelium.

Dilatation of the connective tissue diaphragm, to the extent of permitting the passage of the fetal head, demands a great stretching of this poorly contractile tissue, which of itself could not assume its original dimensions as it contains little, if any, elastic tissue. The return to the normal postpartum state is assisted by the closely associated smooth muscle diaphragm which has the power of greater extensibility. The fibromuscular diaphragm is not necessarily injured in normal childbirth. Dilatation of the

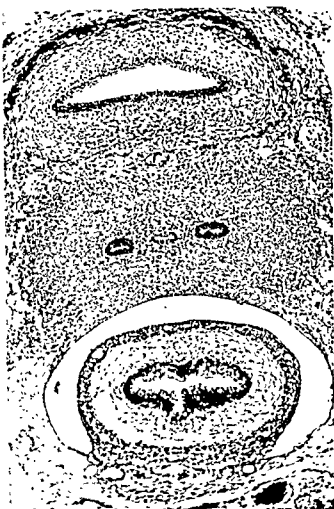


Fig. 4. (Fetus 37 mm. C.R.L.) Urogenital sinus in front. Transversus mesodermal bar containing the united Mullerian ducts in the center and Wolffian ducts on either side.

uterus and cervical canal will slacken the tautness of the fibromuscular diaphragm, while return to the normal size of this viscus will renew the tension of the musculofascial diaphragm.

#### THE LEVATOR ANI MUSCULAR DIAPHRAGM

This "ununiform" muscular plane spans the pelvis obliquely, stretching anteroposteriorly from the symphysis pubis to the sacrum and coccyx. Laterally from the levator ani white line, extending medially and caudally to the external sphincter of the anus, to the anococcygeal raphe, the sacrum, and coccyx.

The general sloping trend of the fibers medially and caudally give this muscle a somewhat "cup-shaped" appearance, with a trough-like exit beneath the symphysis pubis—where the medial arms of the pubococcygeal

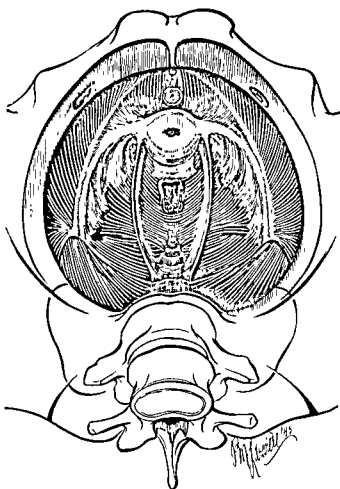


Fig. 5. Viewed from above. Showing the three surfaces of the lateral ligament. Like looking at the side of a funnel.

segment enclose two clefts. An anterior one, the urethrovaginal, and an anal one, posterior to the perineal body. While the origin of this diaphragm is fixed to bone, particularly its anterior and posterior segments, its insertion is mobile, the significance of this fact increases with parturition.

From an obstetrical viewpoint the levator ani muscular diaphragm on each side consists of three segments—an anterior or pubococcygeal, a middle or iliococcygeal, and a posterior or ischiococcygeal. These bifurcated muscles take an extensive origin from bone and fascia.

The anterior segment consists of the pubococcygeus muscle, by far the most important of the three segments. It forms the largest, strongest, thickest, and most important part of the pelvic floor. Its fibers have a bony origin from the posterior wall of the symphysis pubis beneath the levator ani white line; and



In the normal adult this cavity contains areolar tissue and unstriated muscle. Smooth muscle fibers extending from the upper third of the vaginal wall are attached to the inferior aspect of the superior and posterior surfaces of the ligament (Fig. 8).

The posterior segment is the largest of the three areas, and its fascia the most attenuated because of the passage of the rectum. The most condensed fibers extend from the posterior inferior aspect of the supravaginal fascial collar, and terminate in the second and third sacral vertebrae. These fibers are known as the uterosacral ligaments. That space behind the cervix, bounded by the uterosacral ligaments laterally and the rectum posteriorly is known as the pouch of Douglas (Fig. 5). This is the bottom of the abdominal cavity; here the fascial diaphragm is thinnest. In frontal section, descending caudally from the posterior margin of the supravaginal collar is a tongue-like reef of fascia extending between the posterior vaginal wall and the anterior rectal wall and terminating in the perineal body. This caudal prolongation is known as the rectovaginal septum.

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The iliococcygeus lies posterior to, and on a deeper plane than, the pubococcygeus. Viewing the pelvic floor from above (Figs. 3, 5, 6, 10) actually it is more superficial. It is attached to the arcus tendineus behind the obturator canal and is inserted into the anococcygeal body and into the margins of the coccyx, lateral and caudal to the fibers of the pubococcygeus. Occasionally this muscle retains its primitive origin from the pelvic brim. In lower animals it has a flat tendinous origin from the iliopectineal line. Since it has lost its original purpose in man it is poorly developed, and has slipped lower down on the pelvic wall. Its fascial point of attachment has become elongated, therefore, so that the fibers of origin of the muscle do not, except in a few instances, extend to such a degree as the iliopectineal line.

In most cases in the dissecting room, muscle fibers can be demonstrated only at a considerable distance from the point of origin of this muscle.

The elongated and thinned out "aponeurosis" of the iliococcygeus muscle is seen to be intimately fused with the sheath of the obturator internus muscle.

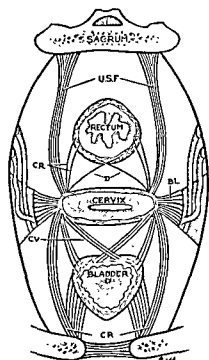


Fig. 9. Schematic transverse section of smooth muscle diaphragm. U.S.F., Uterosacral fibers; C.R., cervico-rectal fibers; D., decussation fibers; B.L., broad ligament fibers; C.V., cervico-vesical fibers; C.P., cervicopubic fibers.

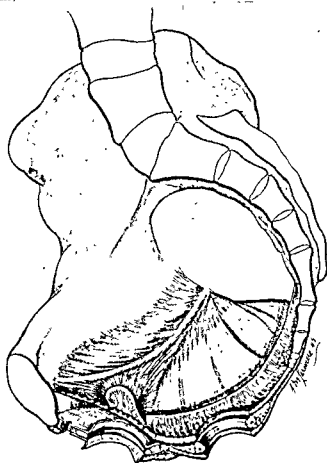


Fig. 10. Semidiagrammatic mesial section of pelvis, showing the mutual relationships of the components of the pelvic diaphragm. Notice especially the upper and lower leaves of the urogenital diaphragm.

The fusion of the remains of the aponeurosis of the iliococcygeus with the fascial covering of the obturator internus muscle forms a composite sheath of fascia, the so called obturator fascia. The line of fusion between these two fasciae is of considerable clinical importance, in that it defines the upper limit of the ischio-rectal fossa.

The so called "white line" does not accurately indicate the upper limit of the iliococcygeus muscle but rather an arrangement of its fascial investment. This fascia is subject to tension between two fixed points and has become condensed. In this instance the fascial fibers of the sheath of the levator ani form a narrow band popularly referred to as the "levator ani white line," which extends from its point of attachment on the posterior aspect of the pubis to the spine of the ischium. The white line, therefore, appears to cross the

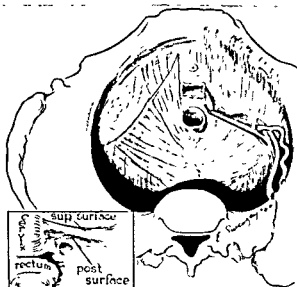


Fig. 6. Semidiagrammatic representation of pelvic floor with right lateral cervical ligament shown in position (On the left side the fascia has been removed to show the underlying muscles.) At the lateral end of this ligament the uterine artery can be seen crossing the ureter. At the medial end of the ligament the inverted U-shaped outline is well shown. The small insert shows the ligament from behind. Note the hiatus at the lower border of the posterior surface.

from the arcus tendineus in front of the obturator canal. From this origin its fibers sweep backward as three distinct bands, the most medial fibers form a U loop around the vagina



Fig. 7. Dissection. Lateral ligament of cervix uteri (Mackenrodt) viewed from above presenting superior surface. (Probe under ureter.)

and are inserted into the "central point" of the perineum with firm attachment to the cranial leaf of the urogenital diaphragm. These fibers constitute the "pubovaginals." A thin bundle is confluent with the urethralis muscle.

The intermediate fibers resemble a horse shoe attached by its anterior extremities to the pubis and encircling the rectum behind, forming a U loop around the anorectal junction. These fibers constitute the puborectalis or sling muscle, which slings the anal canal up to the symphysis pubis. Some fibers from this bundle insert into the anococcygeal raphe.

The most lateral fibers have a Y shaped insertion into the anococcygeal raphe—the margins and ventral surface of the coccyx. This muscle forms a sphincter for the vagina and anal canal, and also increases the anorectal angulation. It gives off accessory fibers to the urethralis muscle, which act as an accessory sphincter of the urethra.



Fig. 8. Dissection. Seen directly from above. Lateral cervical ligament (Mackenrodt). Uterus and uterine artery deflected posteriorly. Ureter in position. 1, Superior surface; 2, smooth muscle fibers; 3, cervicovesical junction.

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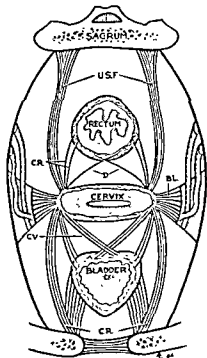


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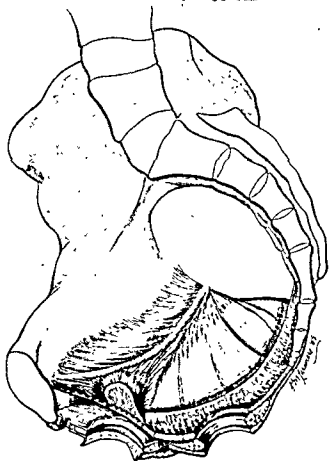


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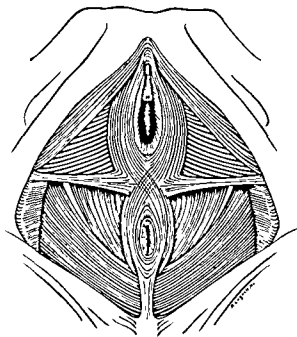


Fig. 11. Schematic representation of the sphincteric muscular group of the pelvic floor.

pubococcygeus muscle because unlike the iliococcygeus, the former has not descended. The white line in some cases is found separated by some little distance from the pelvic wall and when this is so a pouch—the “hiatus of Schwalbe”—filled with fat, exists between the two.

The D shaped opening of the anus, previous to expulsion of the fetal head, is due to extension of the fibers of the puborectalis and iliococcygeus which are inserted into the ano-coccygeal raphe.

The ischiococcygeus with the piriformis forms the muscular upholstery which closes the posterior part of the pelvic outlet. Posteriorly and caudally it is reinforced by the sacrotuberous ligament (great sacrosciatic ligament). This triangular muscle is set at almost a right angular plane to the iliococcygeus. It arises from the apex of the ischial spine and is inserted fan-shapedwise into the lateral border of the sacrum and into the lateral margins of the coccygeal bodies, conjointly with the iliococcygeus muscle.

The individual muscle sections of the pelvic diaphragm do not by any means form a uniform sheath in one plane, but overlap one another posteriorly where they join and interdigitate with the muscle fibers of the other

side. By this means the part of the diaphragm posterior to the rectum is clearly strengthened.

**Morphology.** In pronograde animals there are three caudal muscles; the pubococcygeus, arising from the body of the pubis, the iliococcygeus arising from the pelvic brim, both of which are tail depressors, and the ischiococcygeus, a lateral flexor of the tail arising from the ischial spine. With the disappearance of the tail in man and the assumption of the upright position, the tail muscles take over new duties and form a pelvic floor for the support of the pelvic viscera. The pubococcygeus and the ischiococcygeus muscles retain their primitive origins, but the iliococcygeus loses its attachment to the pelvic brim and gains a new attachment to the lateral pelvic wall at the arcus tendineus. While the caudal muscles gain extensive new insertions into the pelvic floor, they still retain their original insertion into the coccyx, which is the rudimentary tail. Thus, while the levator ani muscular diaphragm contributes to the support of the viscera, the muscles which constitute it are derived from the flexors and abductors of caudal end of vertebral column.

#### THE UROGENITAL DIAPHRAGM

The urogenital diaphragm is a relatively inelastic double-leaved fascial envelope, extending between the ascending pubic rami and beneath the subpubic arch, to whose margins it is firmly attached (Figs. 3, 10, 13 to 18). It closes over the perineal triangle, while its so called free margin extends between the ischial tuberosities, demarcating the posterior boundary line of the perineal triangle. It is perforated by the dorsal vein of the clitoris, the urethra, and vagina. It contains the pudendal vessels and nerves and the membranous urethra, the sphincter urethrae and transversus perinei profundus muscles. This latter muscle is supportive to the vaginal wall.

The pubococcygeal segment of the levator ani muscle plays on its cranial fascia into which fibers of this muscle find a firm attachment. Thus the integrity of this fascial leaf prevents within certain limits the separation of the pubococcygeal segment. The wedge-shaped, anteriorly directed diverticulum of the ischio-rectal fossa extends between the

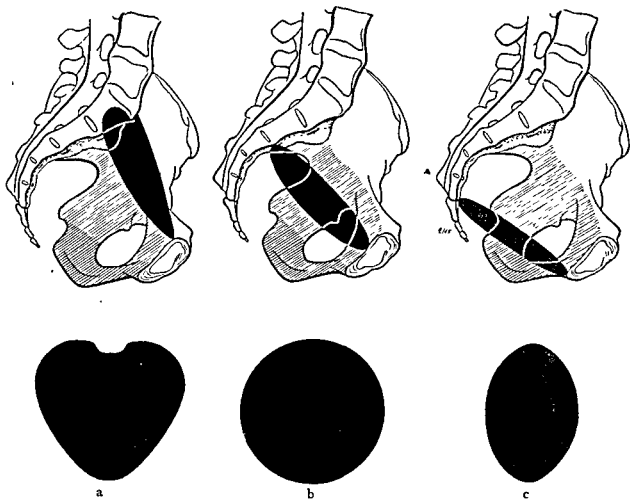


Fig. 12. (Silhouettes) a, Android inlet; b, midpelvic plane, round; c, level of ischial spines and plane of pelvic floor, spheroidal.

pubococcygeus muscle and its cranial fascia. Its caudal fascia gives attachment to the sphincteric vulval musculature. With the body in the erect position, the urogenital diaphragm, like the os pubis and its rami, is in a horizontal plane, so that support of the pelvic viscera falls upon these structures.

#### THE SPHINCTERIC MUSCULAR DIAPHRAGM

While this group offers some supportive action it is primarily sphincteric in contradistinction to the levator ani muscular diaphragm which is primarily supportive and only secondarily sphincteric to the pelvic viscera. It forms sphincters for the openings of the canals which perforate the pelvic floor to reach the exterior. It is derived from the primitive sphincter cloacae, a primitive muscular ring surrounding the cloaca, which is partly attached to the bones at the pelvic outlet.

During the course of the development of the genitourinary organs a cloacal aperture exists till about the 5th week, and a sphincter muscle is arranged about it—the primitive sphincter cloacae. About this time a caudal prolongation of the transverse mesodermal bar takes place dividing the cloaca into two parts, a dorsal or anal, and a ventral or urogenital, and coincident with this change the sphincter cloacae becomes divided into dorsal and ventral divisions, the former surrounding the anal aperture and constituting the sphincter ani externus, the ventral surrounding the urogenital sinus. It is from the urogenital division that the bulbocavernosus, the transversus perinei and the sphincter urethralis muscles develop (Fig. 11).

#### ACCESSORY STRUCTURES

*Perineal body.* The perineal body or central tendon of the perineum is a triangular wedge

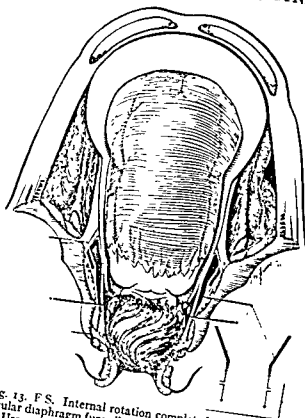


Fig. 13. F.S. Internal rotation completed. Levator ani muscular diaphragm funnelled. Head in axis of pelvic outlet. Urogenital diaphragm opening. Upper leaf being pulled upward by dilatation of vagina and pubococcygeal segment. Lower leaf being pushed downward by descending head. Coiffure of hair indicating direction of rotation.

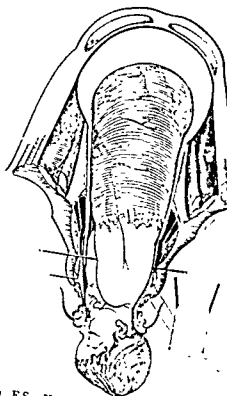


Fig. 14. F.S. Uterovaginal canal converted into a continuous hiatus. Lateral ligaments of the cervix are flattened peripherally and stretched vertically to their maximum. Levator ani muscular diaphragm changed to vertical plane. Urogenital diaphragm widely opened. Internal rotation completed.

of tissue whose base is represented by the skin surface existing between the posterior commissure of the vagina and the anterior margin of the anus. Its apex is demarcated by the line of juxtaposition of the posterior vaginal wall and the anterior rectal wall. It is made up of fat, connective tissue, voluntary and smooth muscle fibers. Laterally it receives fascial lamella from the perivaginal and perivaginal septum extending from the supra-apex. This structure is analogous to the hub of a wheel or the ring of a parachute, into which is inserted each one of the diaphragms constituting the pelvic floor. It has been popularly called the tendo achillis of the perineum. The perineal body is the "keystone" of support to each of the various diaphragms constituting the pelvic floor. Injury to the perineal body is reflected in each of these structures. The baby has to come down the

uterovaginal canal to make its exit. The vulva at the anterior end contains the bony untensile platform. However, the symphysis pubis opens slightly and the coccyx is displaced downward and backward. The visceral structures with their fascial attachments move upward, the muscular segment, the levator ani moves downward and backward and both segments are canalized. The pelvic floor has to be opened and closed; to be opened, it is displaced backward and downward. If it is damaged, it cannot be completely closed. A torn and damaged perineal body is going to prevent return to integrity.

*Gluteus maximus muscle.* The levator ani muscular diaphragm receives support from the two gluteus maximus muscles. These muscles are a source of strength capable of presenting great counterpressure to the powerful muscles of the ventral wall and the respiratory diaphragm. The lower medial fibers of the muscles pass downward and backward from the

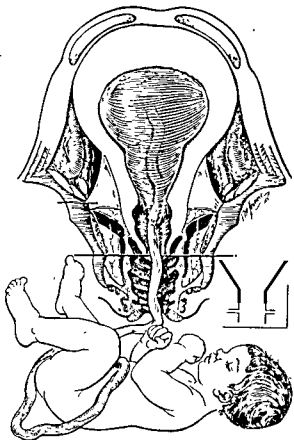


Fig. 15. F.S. Baby expelled. Lower uterine segment fibers regaining contractility and its canal diminishing in volume. Lateral ligaments of the cervix uteri assuming axial arrangement. Levator ani muscular diaphragm fibers regaining oblique plane. Urogenital diaphragm closing.

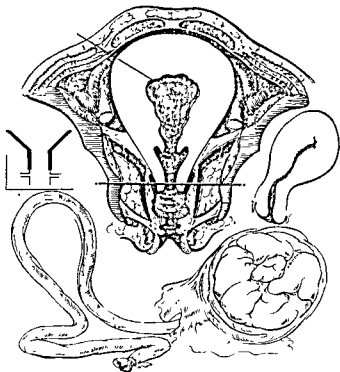


Fig. 16. F.S. Restitution. Placenta expelled. Cervix withdrawn cranially to level of ischial spines. Lateral ligaments of the cervix uteri in normal axial pregravid plane. Levator ani muscular diaphragm in oblique plane. Urogenital diaphragm closed.

muscular diaphragm. The fat pad is continuous with the fat of the adjacent superficial fascia. The superficial fat of perineum and the apposition of medial aspects of the thighs also act as accessory, supportive structures.

#### THE COURSE OF PARTURITION

The bony pelvis is a funnel-shaped bony cage with a bend resembling the elbow of a stovepipe. Its gently sloping walls and muscular upholstery offer deflecting surfaces to the fetal head during parturition. It possesses a bore, similar to that of a turbine, or rifle—the fetus representing the bullet which, passing through, must make certain turns in order to accommodate itself to the unequal bore of the pelvis.

Previous to the onset of labor the fetal head rides at ease in the "military position" above the obstetrical inlet, the posterior quadrant of which passes through the body of the first sacral vertebra, the longitudinal axis of the fetal ovoid being parallel with the vertebral column of the mother (Figs. 17, 18).

With labor established, the fetal head is first "jockeyed" into one of the oblique diameters

coccyx, separated from each other by an angle of 30 degrees and connected by tough, intervening connective tissue. They underlie each ischiorectal fossa and support the pelvic diaphragm very powerfully through the pad of fat which fills these fossae. The fat pad in the ischiorectal fossa is made up of small masses of fat with powerful strings of connective tissue fibers intervening with one another and connected with the walls of the fossa, with the perimysium externum of the internal obturator and gluteus maximus muscles and with the caudal fascia of the urogenital diaphragm, which limits the ischiorectal fossa anteriorly. The fat pad lies under the levator ani muscular diaphragm throughout its extent and so forms a cushionlike support which, though soft and pliable, transmits to the levator ani muscular diaphragm all the strength and security given it by the gluteus maximus muscles and the powerful urogenital diaphragm. These offer real strength and support to the levator ani



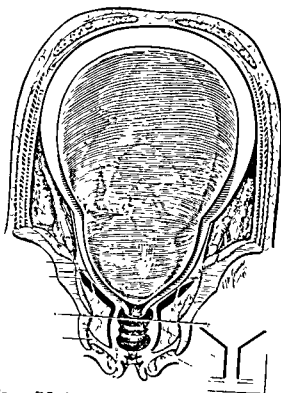


Fig. 17. F.S. Schematic frontal section slightly anterior to bisected anteroposterior diameter of pelvic inlet. Labor established. Head "centered" in axis of inlet. Membranes intact. Lower uterine segment unfolding. External os dilating. Lateral ligaments of the cervix uteri flattening peripherally and elongating vertically. Levator ani muscular diaphragm receiving pressure from the fetal head. Urogenital diaphragm intact.

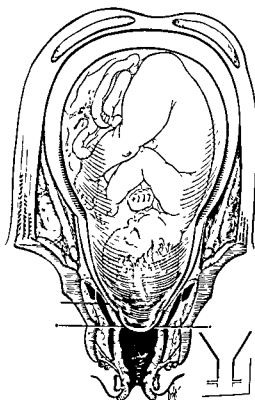


Fig. 18. F.S. Lower uterine segment further unfolded. Membranes bulging. External os further dilated. Peripheral and vertical stretching of the lateral ligaments of the cervix uteri. Levator ani muscular diaphragm being funnelled. Vaginal fornices pulled upward. Urogenital diaphragm intact.

of the pelvic inlet, usually the right, this being the relatively larger of the two diameters, its sagittal suture passing from the oblique to the transverse diameter of the obstetrical inlet. The passenger is then propelled along the road of birth, the axis of which is backward and downward to the ischial spines (Figs. 12c, 19) the area of least dimensions, which is also the plane of origin of the pelvic floor; then forward and slightly upward through the pelvic outlet. The bore of the road of birth causes the passenger to make three turns during its voyage, one at the inlet, a second at the ischial spines (internal rotation), and a third (external rotation) which is on the balcony of soft parts beyond the bony pelvis (Figs. 12, 14).

When the descending head strikes the pelvic floor, the muscular segments react by increased oscillations, thus temporarily assuming a horizontal plane. When the muscular

resistance is overcome, a vertical plane is assumed and the levator ani muscle is said to be "funnelled."

The levator ani muscular segments are funnelled from behind forward. The ischio-coccygeus is the first to receive the impact of the fetal head, but the head is preceded by the membranes filled with fluid forming a wedge whose narrow lower end slips into the vagina and really transfers most of the pressure onto the front of the pubococcygeus just where it passes into the perineal body. Thus the anococcygeal raphe is pushed down at its anterior end until it becomes ventral, and the ischiococcygeus, which is set at almost a right angular plane to the iliococcygeus, assumes a vertical plane and acts as a deflecting surface to the descending head. With the propelling force of the contracting upper uterine segment, the head is deflected downward and forward onto the fibers of the iliococcygeus

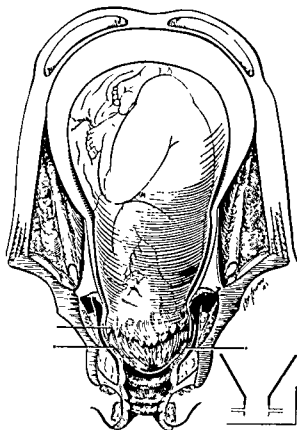


Fig. 19. F.S. Membranes ruptured. Descent of head to ischial spines. Sagittal suture is in oblique plane. Further flattening and stretching of the lateral ligaments of the cervix uteri. Fibers of the levator ani muscular diaphragm changing from oblique to vertical direction. Pull being exerted on upper leaf of the urogenital diaphragm.

muscle. The fibers of this muscle slope medially and caudally; their resistance is soon overcome and the head is then shunted on to the pubococcygeal segment, which is stretched anteroposteriorly and peripherally. As the peripheral dilatation of its fibers takes place, the urogenital diaphragm is opened. The adjacent cranial leaf of the urogenital diaphragm turns upward on the sides of the vagina and has attached to it the fibers of the pubococcygeal muscle. Thus, as the vagina dilates and the pubococcygeus is dilated peripherally the cranial leaf of the diaphragm is pulled upward. The caudal diaphragmatic leaf is pushed downward as the head is propelled along the axis of the pelvic outlet (Figs. 10, 13, 14). The transversus perinei profundus muscle is flattened peripherally and stretched vertically, its fibers being dispersed between the upper and lower fascial leaves. The rectovaginal septal fibers are stretched peripherally and longitudinally. This septum can

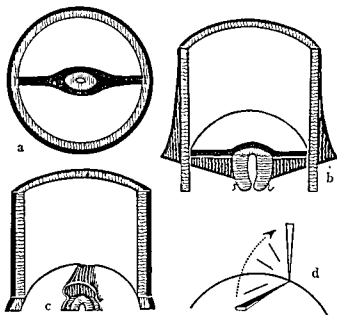


Fig. 20. a, Transverse section of cervix and supravaginal fascia. Center, cervix. Cervix represented by light wavy lines. Fascial collar by heavy dark lines. b, Frontal section. Effaced lower uterine segment and adjacent elongated fascia in vertical plane. Peripherally dilated in transverse plane. c, Sagittal section. Center, cervix and lateral ligament of the cervix uteri at rest. Periphery, in dilatation. d, Action. Diagram illustrating flattening and elongation of lateral ligaments of the cervix uteri. These ligaments flatten peripherally with dilatation of the lower uterine segment and elongate with its vertical stretching.

sometimes be seen being pushed in front of the descending head, if stretched beyond its elastic capacity, this structure tears, either vertically or transversely, severing its continuity with the perineal body.

As the sphincteric group of muscles are dilated they are converted into a short muscular tube along the axis of the pelvic outlet. Their stretched fibers extend beyond the bony framework. When the biparietal diameter of the fetal head reaches the transverse diameter of the pelvic outlet, the perineum bulges for a distance of 1.5 to 2 inches. Coincident with this bulging, or "crowning," the coccyx and anococcygeal raphe are being displaced downward and backward. The posterior fibers of the external sphincter, which are attached to the anococcygeal raphe, are stretched and pull the anus open in a D-shaped fashion. At this moment the uterovaginal canal is converted into one continuous hiatus (Figs. 1, 14). The lateral ligaments of the cervix uteri are flattened peripherally and stretched vertically. The smooth muscle diaphragm is dilated spherically and the leva-

tor ani muscular diaphragm changed from an oblique to a vertical plane. The urogenital diaphragm is opened and the sphincteric diaphragm dilated spherically, followed by dilatation of Colles' fascia and the skin surface.

While the lower uterine segment starts to unfold at the fourth month of intrauterine life, it is only fully developed as a mechanical product of labor. Synchronously with the unfolding of the lower uterine segment, a hypertrophy and a hyperplasia of the supra-cervical fascial collar takes place. As the lower uterine segment widens and elongates, the fascial collar correspondingly follows it. With the establishment of labor the lateral ligaments of the cervix uteri have grown and stretched considerably in size so that, metaphorically, they may be likened to the stretching of a rubber to that of a rubber boot. At the moment of expulsion of the fetal head, the uterovaginal canal is converted into one continuous hiatus, the lateral ligaments of the cervix uteri are flattened peripherally and elongated vertically. When the baby is expelled, the lower uterine segment regains its contractility and its calibre is diminished with a corresponding contractility and reduction in size of the stretched endopelvic fascial structures. The lateral ligaments of the cervix uteri contract in their vertical length and regain their axial arrangement in the horizontal plane (Fig. 15).

With the expulsion of the placenta, the caliber of the lower uterine segment is further reduced. The cervix rises to the ischial spines. The lateral ligaments of the cervix uteri assume their pregravid axial arrangement (Fig. 16). The anterior and posterior fundal walls are in apposition, being separated only by filamentous bands of fibrin and blood clot. Further involution follows provided the anatomical integrity of the supporting pelvic structures has been maintained. The fascial diaphragm is likewise favorably affected by involution or unfavorably affected by subinvolution. Trauma or infection of the isthmocervical canal will likewise affect the adjacent fascial supports. Should the fascial and levator ani muscular diaphragms be traumatized and unrepaired, prolapse will inevitably follow.

#### THE CLINICAL SIGNIFICANCE OF THE PELVIC FASCIA IN OBSTETRICS

*The endopelvic fascia—as an extensive fixation apparatus moors the uterus to the levator ani white line and to the pelvic floor.*

*The lower uterine segment and its fascial supports represent an active force in determining the axis along which the fetal head must descend through the pelvis.*

*The fascial attachments of the lower pole of the uterus influence the fetal ovoid in its descent through the pelvis.*

The fascial supports of the uterus have received many names. Among others, the following designated titles have been applied: the parametrium (Virchow), the cardinal ligaments (Kock), the vascular sheath (Charpy), the hypogastric sheath (Pierre Delbet), the uteroiliac process (Savage), ligamentum lata, tunica vasorum uteri (Merkel), ligamentum transversale colli (Mackenrodt), the sustentacular apparatus (Bonney), the lateral cervicopelvic ligaments, the upper pelvic floor (Polls).

The anglicized version, namely, "the lateral ligament of the cervix uteri" is a more meaningful and purposeful terminology, and in keeping with the principles accepted at Basle, in 1895, by the Anatomical Society.

Because of its fixation to the elastic levator ani white line laterally, and to the supravaginal cervix medially, with the formation of the lower uterine segment this fascial diaphragm hugs the lower uterine segment, and is elongated in a cranial direction assuming somewhat the topographical outline of an inverted expanding funnel or inverted Medici collar. Its weakest point is posteriorly between the uterosacral ligaments where the fascial collar is thinnest. Metaphorically, it may be said to be stretched from the "size of a rubber to that of a rubber-boot."

The lower uterine segment is formed from the body of the uterus, the isthmus and cervix. In full development it is a mechanical product of labor, being the passive or accordianated portion of the cervicouterine canal. The contraction ring not only marks the line of demarcation between the contractile part of the uterus and the lower uterine segment but also delineates the cranial attachment of the

# THE USE OF TYROTHRIN IN SURGICAL INFECTIONS

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THE peculiarities of a surgical infection are such that they frequently respond best to agents applied directly to the site of infection. With the new therapeutic era opened by the antibiotics, interest in the development of locally applied antibiotics was only natural. Among the first of these to be discovered was gramicidin, described by Dubos in 1939. It was found to be lethal to gram positive cocci (7, 8, 10, 11, 13, 16, 22) and effective in the treatment of a large variety of streptococcal lesions of the skin, sinuses, pleura, and bone (9, 12). The material was not destructive in its effect on tissues except for a pronounced hemolytic effect upon erythrocytes; removal of the hemolytic factor resulted in a loss of its bacteriocidal powers (14). In its antibacterial behavior it acted like an anionic detergent (15). In comparison with another closely related antibiotic, tyrocidin, gramicidin was found to be less stable, slightly more cytotoxic, and highly insoluble; tyrocidin could keep gramicidin in suspension and had more of an inhibiting effect on certain gram negative flora.

It was later found that the crude material which contained both gramicidin and tyrocidin could combine the bacterial potency of the former with the stability and solubility of the latter. The crude material—tyrothricin—represents the form in which these antibiotics are now being applied. Preliminary reports have indicated a wide field of usefulness of this drug (5, 9, 19, 22) but in the enthusiasm for the use of penicillin, few controlled clinical studies have been undertaken to evaluate this antibiotic, in spite of the fact that it offered certain theoretical advantages over penicillin.

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In the first place, tyrothricin has been found to have a more rapid lethal effect upon sensitive organisms. Second, because of low absorption and penetration through tissues, a higher local concentration could be attained. A decreased excretion would also enhance the local concentration, a greater stability ensures prolonged action, and because of the high dilutions at which tyrothricin is still effective, it becomes clinically an inexpensive antibiotic.

The following study was outlined to investigate a specific tyrothricin preparation made available to use for this purpose:

1. To observe the clinical effectiveness of tyrothricin in the treatment of a variety of surgical lesions as judged by changes in the exudate, area of the wound, granulation, and pain.

2. To observe the effect of tyrothricin upon normal and inflamed tissues.

3. To observe signs of local and systemic toxicity.

4. To study the effect of tyrothricin upon the bacteriological flora of the wound.

5. To observe evidences of hemolysis by following the changes in the hematocrit, hemoglobin, and icteric index.

6. To compare tyrothricin with other methods of treatment.

## METHOD OF STUDY

The project was undertaken by a team consisting of two nurses, a bacteriologist, a hematological technician, a photographer, and a surgeon. The same nurses dressed the wounds to standardize the method of dressings, the obtaining of cultures, and the preparation of the solutions. The same bacteriologist carried out the bacteriological studies throughout the period of the study. The surgeon selected all cases for treatment and determined the clinical result.

The tyrothricin used in this study was furnished to us as a 2.5 per cent alcoholic solution in a sterile ampul containing 20 cubic

centimeters of the material. This was added to a liter flask of sterile distilled water, thus making a solution that contained approximately  $\frac{1}{2}$  milligram of tyrothricin per cubic centimeter of solution. Toward the end of the study in a few cases, a more concentrated preparation was used (1 mgm. per c.c.) or 40 cubic centimeters of the 2.5 per cent solution diluted to a liter. This was done for comparative purposes to note the effect of the stronger solution on the speed of healing. All solutions were made up freshly each day and any unused solution was discarded at the end of the day.

At the beginning of tyrothricin therapy, all wounds were photographed. The photographs were identified in the same manner as roentgen-ray films and a metric scale on the marker provided a means of permanently recording the size of the wound, which we found correlated well with actual measurements of the wound, for the differences recorded far exceeded the possible error. Special mimeographed sheets provided columns for entries of pertinent details of the clinical history and permitted daily entry of data concerning the treatment, changes in the wound, the quantity of the drug used, temperature, pulse, respiration, and all the laboratory data. The photographs were retaken at weekly or biweekly intervals as indicated. Cultures and venous blood for hematological study were also taken before the start of the therapy.

Tyrothricin was used in the form of a wet gauze dressing. The quantity of solution necessary to saturate the gauze was measured in a sterile graduate before application. The moist gauze was then packed loosely into the wound, an absorbent placed over the gauze, followed by a layer of cellophane, parchment, or wax paper to control evaporation or loss of tyrothricin solution. Dressings were held in place by gauze rolls, adhesive, binders, or splints as the lesion required. Dressings were changed daily by the same personnel.

The bacteriological procedure was carried out as follows. The nurse dressing the wound was carefully instructed to remove the same amount of exudate from approximately the same area of the wound so that the bacteriological counts might be standardized as much

as possible. At first the cultures were taken daily, but we soon learned that cultures taken every 2 or 3 days were frequent enough. The exudate was recovered by a dry sterile swab which was immediately placed into a test tube containing 2 cubic centimeters of sterile distilled water to help keep the cultures moist. All swabs reached the bacteriologist within 1 hour from the time they were taken from the wound. The bacteriologist agitated the swab in the water to displace as many of the bacteria as possible, and then the swab was placed in a tube of brain broth. The brain broth was incubated at 37 degrees C. for 24 hours after which a gram stain was made and examined microscopically. One tenth cubic centimeter of the distilled water containing the organisms was inoculated deeply into melted agar containing 0.2 cubic centimeter of blood, and poured into a sterile plate. The plate was incubated for 48 hours aerobically at 37 degrees C. after which time the colonies were counted. When it was anticipated that the infection was extremely heavy, appropriate dilutions of the original samples were made in distilled water. A special effort was made to differentiate streptococci, staphylococci, diphtheroids, and gram negative bacilli, particularly *Pseudomonas pyocyaneus*. A 4 millimeter loopful of the specimen was streaked on a blood agar plate and incubated aerobically at 37 degrees C. for 48 hours. At the end of this time well isolated colonies of varying morphology were transferred to blood agar slants and identified (2). At first a second plate was streaked and incubated anaerobically in a platinum catalyst type anaerobic jar, illuminating gas being used instead of hydrogen gas. It was soon found that so few of the wounds possessed an anaerobic flora, that it was unnecessary to use anaerobic technique routinely. Instead, the brain broth culture, described in the foregoing, was examined and when any suspiciously appearing gram positive rods were found, an anaerobic streak plate was prepared from the brain broth. Anaerobes were identified by the use of the technique described by Reed and Orr.

Hematological studies were carried out on venous blood drawn before the start of the therapy and at weekly intervals thereafter.

Heparin was used as the anticoagulant for plasma. Determinations included the sedimentation rate, hematocrit, hemoglobin, total serum protein, and icteric index. The sedimentation rate was performed by the Wintrobe method, correction being made for abnormally low hematocrits. Hemoglobin determinations were made on heparinized venous blood, the photoelectric method being used. Total serum proteins were studied by the specific gravity method of Barbour-Hamilton. Icteric indices were carried out on serum in the usual manner.

#### MATERIAL

The clinical material studied is listed in Table I. It consists of 77 cases of surgical infections of a wide variety such as is encountered in the charity wards of a general hospital. No deliberate attempt was made to select cases, but certain fundamental surgical principles were followed: i.e., only draining infections which communicated with the exterior were considered. At first no attention was paid to the blood supply of the part but it was soon learned that the treatment was doomed to failure in the presence of gangrene. Infected postoperative wounds were the most frequent lesions treated, of which there were 19. Infected varicose ulcers were next in frequency and constituted a group of 10 patients. There were 7 patients with cellulitis and 7 with abscesses, 5 with empyema and 5 with burns. The remainder were quite varied in nature. All patients were hospitalized for the entire period of study and received no other therapy conjointly with the tyrothricin therapy.

There were 49 white and 28 negro patients, 47 being males and 30 females. The oldest patient was 79 years and the youngest 2 years of age. There was an additional group of patients studied privately in other hospitals but these are not included for statistical appraisal because either the photographic evidence or the bacteriological studies were incomplete.

The majority of these patients were referred to us after their lesions had proved refractory to a variety of other methods of treatment, which included the use of Dakin's solution,

Dakin's with saline, saline packs, sulfonamides, xeroform gauze, vaseline gauze, boric acid solution, ultraviolet light, and parenteral penicillin. These, therefore, act as control measures in evaluating the drug under investigation. Included were 6 cases with bilateral lesions in which one lesion was treated with tyrothricin and another with a control preparation. These we feel offer more crucial tests of comparison than a parallel series of patients with unilateral lesions. The variability among patients and types and degree of infections is so numerous that only a series of several hundred cases would offer statistically significant evidence.

#### RESULTS

*A. Clinical.* The criteria for clinical improvement in the treatment of the infection included the disappearance of all visible signs of infection, the decrease in the amount of exudate, the growth of viable healthy granulation tissue, the growth of epithelium over the granulation tissue, and a decrease in the size of the wound as verified by actual measurement. According to these criteria, clinical results were placed in three categories: excellent, fair, and poor.

Table I lists the various infections treated with the results evaluated as indicated above. Of 77 cases treated, 50 (65 per cent) showed excellent results, 8 (10 per cent) showed fair results, and 19 (25 per cent) showed poor results. It will be noted that 18 out of 19 cases of postoperative wound infection responded with excellent results and one gave a poor result. In the 10 cases of infected varicose ulcers, there were 7 excellent results with tyrothricin treatment, 1 was fair and 2 were poor. All of 7 cases with cellulitis responded excellently, whereas of the 7 cases of abscesses, 5 showed an excellent result and 2 poor, the latter were ischiorectal abscesses in debilitated patients. Four of the 5 patients with empyema and open drainage responded well to tyrothricin. In 1 case of an abscess due to Friedlaender's bacillus infection, the result was only fair. Of 5 infected burns treated, the result was excellent in 1, fair in another, and poor in 3. All 3 cases of decubitus ulcers responded excellently. Two of three lacerations

TABLE I.—CLINICAL RESULTS IN 77 PATIENTS WITH SURGICAL INFECTIONS TREATED WITH TYROTHRICIN

Lesion	No. of Cases	Excellent result	Fair result	Poor result
Postoperative wound	10	18		
Varicose ulcer	10	7	1	2 (1-rash)
Cellulitis	7	7		
Abscess	7	5		2
Empyema	5	4	1	
Burn	5	1	1	3
Laceration	3	2		1
Osteomyelitis	3			3
Decubitus ulcer	3	3		
Carcinomatous ulcer	2		1	1
Carbuncle	2		2	
Luetic ulcer	2	1		1
Infected dermatitis	2	1	1	
Infected amputation stump	2	1	1	
Buerger's disease	1			1
Infected fracture	1			1
X-ray burn	1			1
Tenosynovitis	1			1
Fistulae (perinephric)	1			1
Totals	77	50 (65%)	8 (10%)	19 (25%)

TABLE II.—DURATION OF TREATMENT WITH TYROTHRICIN OF 77 PATIENTS WITH SURGICAL INFECTIONS

Length of treatment Weeks	Clinical result		
	Excellent	Fair	Poor
1	4		7
2	11	2	4
3	6	2	5
4	16	3	1
5	7		
6	1		
7	1	1	
8	4		
Total	50	8	19

statistical evaluation. The short time of treatment in the group with poor results was due to the fact that in many of these cases either death or some complication supervened which required discontinuance of treatment.

The speed of healing was usually proportionate to the initial size of the wound. The general clinical impression was gained that tyrothricin solution directly or indirectly speeded the formation of granulation tissue. Epithelization was also promoted so that skin grafting was necessary in only 5 of the 30 cases showing excellent results. Even the decision to do skin grafting was motivated by a desire to shorten the period of hospitalization. By indirect measurement of all wounds as recorded on photographs (instead of direct measurements of the wounds themselves) the percentage decrease in the area of the wound varied from 36 per cent to 100 per cent in the cases showing excellent results, with an average of 70.7 per cent. The number of cases in the group with fair results do not permit statistical evaluation, but the clinical impression was that there was appreciably less healing. In the group with poor results there was little decrease in the size of the wound, and in some cases the wound increased in size.

The 6 cases with bilateral lesions in which tyrothricin was applied on only one lesion merit detailed analysis. The first of this group was that of a severe pyocyanous infection of both hands following third degree burns. The

responded well whereas the third did not. Of 2 secondarily infected luetic ulcers which had not responded to antiluetic therapy alone, 1 showed an excellent result with tyrothricin, and the other a poor one. The patients with carbuncles responded only fairly. Three patients with osteomyelitis (diabetics) and 1 patient each with an infected fracture, an x-ray burn, a carcinomatous ulcer, tenosynovitis, and a perinephric fistula, all did not improve with tyrothricin therapy.

Table II presents the length of treatment required in each of the groups classified as to result. It is to be noted that of the patients with excellent result, 4 responded within 1 week of treatment, 11 within 2 weeks, 6 within 3 weeks, and 16 within 4 weeks of treatment. In other words 37 out of 77 patients responded to tyrothricin with excellent results within 1 month; 13 others required an additional month. The group with fair results is too small for

TABLE III.—TYPE OF SURGICAL INFECTIONS TREATED IN THIS STUDY AND BACTERIAL FLORA SEEN WITH EACH LESION\*

Lesion	No. of cases	Staph. albus	Staph. aureus	B. hem. strep.	Nonhem. strep.	Pyocyanus	Diphtheroids	Staph. citreus	Gram+ anaerobe
Postoperative wound	10	5	15	8	3	10	12		1
Varicose ulcer	10	3	10	4		6	8	2	
Abscess	7		7	4	2	3	6		
Cellulitis	7	1	7	6	2	3	7		
Empyema	5		4	4	2	4	4		
Burn	5	2	4	2		3	4		
Decubitus ulcer	5	1	3	2		2	3		
Laceration	5	2	3	1	1		1		
Osteomyelitis	3		3	1	1		3		
Lytic ulcer	2	1	2	1		2	2		
Infected dermatitis	2	1	1	1		2	2		
Infected amputation stump	2		2	1		2	2		
Carbuncle	2	1	2	1	1		1		
Carcinomatous ulcer	2		2	1		1	2		
Infected fracture	1		1	1		1	1		
X-ray burn	1		1				1		
Tenosynovitis	1	1	1	1			1		
Penetrating fistula	1	1					1		
Borger's disease	1		1			1	1		
Total	72*	10	69	15	10	41	61	2	1

\*Total number of organisms will be greater than total number of cases because each wound will vary as to the number of different organisms it contains.

right hand was treated with tyrothricin while the left was treated with equal parts of boric acid and vinegar; the tyrothricin treated hand did much more poorly and tyrothricin treatment had to be discontinued. The second case of this group was that of a patient with bilateral varicose ulcers of almost identical initial size (Fig. 8). The right ulcer, which was treated with tyrothricin, showed a much more rapid clearance of exudate, granulation, epithelialization, and disappearance of pain, than did the left ulcer which was treated first with Dakin's saline solution and then saline solution alone. Also bacteriologically, the tyrothricin treated wound responded more favorably. Case 3 of this group was that of an infected epidermophytosis and edema of both legs. There was no apparent difference between the leg treated with tyrothricin and the one treated with saline, although the former was the more seriously involved. Case 4 of the group (Fig. 17) involved a patient with varicose ulcer on the right leg measuring 36.1

square centimeters and one on the left leg measuring 7.4 square centimeters. The right ulcer was treated with tyrothricin and the ulcer healed completely in 3 weeks while at the end of the same period the left ulcer, which had been treated with saline, still measured 2 square centimeters. The fifth case was one of hemiplegia and decubitus ulcers on both heels; the right ulcer, treated with tyrothricin for 4 weeks, showed an 80 per cent decrease in area and filled with granulation tissue, while the left one, treated with saline during that time, was still purulent and had not decreased in size. The remaining case of this series was another one of bilateral varicose ulcers in which the ulcer treated with tyrothricin responded about as well as the one treated with Dakin's saline solution although the former wound was by far the larger (Fig. 19).

In the few experiments in which the strength of tyrothricin solution was doubled (1 mgm. per c.c.) the speed of granulation appeared to increase. For example, if the size of the lesion



TABLE IV.—INFLUENCE OF TYROTHRINICIN SOLUTION UPON INDIVIDUAL BACTERIA IN 77 TREATED CASES.

Organism	Colonies disappeared	Colonies decreased	Colonies increased	Colonies appeared
Hemolytic streptococcus Group A*	18	5		
B**	1			5
C***	1	4	3	1
Nonhemolytic streptococcus Group A	2	2		1
B				
C	1	1	1	1
Staphylococcus aureus Group A	16	17	6	1
B	1	3	3	1
C	1	3	11	1
Staphylococcus albus Group A	3	6	4	
B	1			
C	1	2	2	
Pseudomonas pyocyaneus Group A	3	4	4	17
B				5
C	1		6	4
Diphtheroids Group A	4	13	10	11
B	2	2	3	
C	5	1	7	1

\* Group A, treated with excellent results (50 cases)

\*\* B, treated with fair results (8 cases)

\*\*\* C, treated with poor results (19 cases)

in Figures 9, 13, and 20 is compared with some of those in earlier cases (Figs. 2, 3, 7) the increased speed with which these larger lesions became granulated may be attributed to the stronger solution. Similarly, in cases in private practice where a change of tyrothricin dressing could be carried out every 4 hours, a more rapid healing and granulation was noted. Neither the increased strength of the solution nor the more frequent change of dressing produced any tendency to local or systemic reactions.


One patient not included in the series under experimental investigation is of particular interest. The patient was a 29 year old white female who had a hemolytic streptococcal (Meleney) gangrene involving the entire thickness of the abdominal wall of the right lower quadrant down to the musculature, and ex-

tending onto the right thigh and vulva. The patient had received every therapeutic adjunct available including zinc peroxide,  $\text{Na}_2\text{S}_2\text{O}_3$  drugs locally, orally, and intravenously, and parenteral penicillin. Within 8 days of tyrothricin therapy (applied every 4 hours night and day) all signs of necrosis and cellulitis had disappeared, the entire ulcerated area was covered with healthy granulation tissue, and the patient for the first time in several weeks did not require morphine for change of dressings and expressed the desire to get out of bed.

**B. Bacteriological.** The varieties of organisms encountered in each of the various types of lesions and their relative frequency is indicated in Table III. It will be noted that *Staphylococcus aureus* was found most frequently, then the diphtheroids, followed by *Pseudomonas pyocyaneus*, beta hemolytic streptococcus, *Staphylococcus albus*, and alpha nonhemolytic streptococcus. Though the flora in any given patient was identified with consistency, the colony counts at times show unusual variations. This was thought to be due either to an accidental difference in the quantity of exudate removed with the swab or to the pleomorphic nature of the diphtheroids which frequently took on the morphologic features of staphylococci or streptococci. For this reason, in a number of cases, though the total colony count was always estimated, the individual organisms were identified solely as being present or absent.

The detailed effect of treatment upon individual groups of organisms is presented in tabular form in Table IV. It was readily apparent that the beta hemolytic streptococcus was the most susceptible organism treated, followed by the *Staphylococcus aureus*, and then *Staphylococcus albus*. Tyrothricin appeared to have little favorable effect upon gram negative flora as the pyocyaneus and diphtheroids; in fact, these two organisms demonstrated a pronounced tendency either to proliferate or to make their initial appearance in the course of treatment.

A correlation between bacteriological and clinical results was also seen in studying the results indicated in Table IV. For, while all hemolytic streptococci either were killed or decreased in the group that gave excellent



	Control	11 days	2 weeks after skin graft
Bacteriology			
Number of colonies	200,000	32,000	
Staphylococcus albus	+	+	
Staphylococcus aureus	+	+	
Area of wound—sq cm	60.3	60	6
Treatment	Saline dressings	400 mgm. thyrothricin	Skin graft

Fig. 1. Infected traumatic laceration of the hand treated with thyrothricin. After 11 days of treatment there was no significant decrease in the size of the wound but such a marked clearing of all exudate and growth of granulation tissue, that a skin graft was attempted which resulted in a 90 per cent "take." A decrease in the bacteriological colony count was noted.

clinical results, the results in the group that showed poor clinical effect were also poor from the bacteriological point of view. The same correlation could be deduced from studying the responses of *Staphylococcus aureus* to thyrothricin.

The bacteriological findings in the patients with bilateral lesions presented findings of particular interest. In the patient with burns due to frostbite of both hands, the hand treated with thyrothricin revealed before treat-

ment 165,120 colonies of *Staphylococcus albus*, *pyocyaneus*, and *diphtheroids*; after treatment, culture showed less than 100 colonies of *Staphylococcus albus*, but over 1,000,000 colonies of *pyocyaneus* (principally) and *diphtheroids*. The left hand which was treated as the control showed at the start 750,000 colonies of *Staphylococcus aureus*, *pyocyaneus*, and *diphtheroids*, and this rose to 1,008,000 with the same flora. The second case (Fig. 8) bilateral varicose ulcers, showed



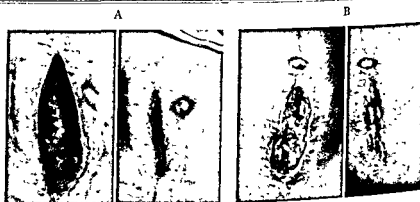
	Control	7 days	16 days	22 days
Bacteriology				
Number of colonies	100,000	100,000	37,120	1,100
Hemolytic streptococcus	+	+	+	0
Staphylococcus albus	+	+	+	+
Diphtheroids	+	0	0	0
Area of wound—sq cm	16	12	2.5	1.8
Treatment	Saline dressings	150 mgm. thyrothricin	310 mgm. thyrothricin	300 mgm. thyrothricin

Fig. 2. Streptococcal cellulitis of the leg with marked edema and induration. Central area around incision for drainage sloughed but within 22 days of treatment with 300 milligrams thyrothricin, the entire area had granulated and epithelized. The bacteriological cultures, which were predominantly hemolytic streptococci, showed a complete disappearance of all streptococci and diphtheroids, and a marked decrease in the number of staphylococci.



	Control	7 days	15 days	25 days
Bacteriology				
Number of colonies	200,000	128,000	20,400	40,400
Hemolytic streptococcus	+	+	+	<100
Staphylococcus aureus	+	+	+	+
Area of wound—sq. cm	11.5	6.2	3.5	2.7
Treatment	Xeroform Dakin's saline	210 mgm. thyrothricin	450 mgm. thyrothricin	875 mgm. thyrothricin

Fig. 3. Infected ulcer of dorsum of left foot which did not respond to Dakin's saline or xeroform gauze dressings. During 4 weeks of treatment with thyrothricin dressings, all purulent exudate disappeared and the ulcerated area filled with granulation tissue which had almost completely epithelized. There was an almost complete disappearance of the hemolytic streptococci and a marked decrease in the number of Staphylococcus aureus.



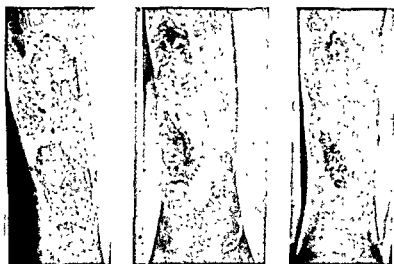
	Control	14 days	Control	14 days
Bacteriology				
Number of colonies	60	1,200	1,800	200
Staphylococcus albus	+	+	+	0
Staphylococcus aureus	0	0	+	0
Bacillus pyocyaneus	0	0	0	+
Diphtheroids	+	+	+	0
Area of wound—sq. cm	36.2	5.0	25	15
Treatment	Dakin's saline dressings	185 mgm. thyrothricin	Saline dressings	875 mgm. thyrothricin

Fig. 4. A, An infected postoperative abdominal wound which had decreased from 36.2 to 5.0 square centimeters in 14 days of treatment with thyrothricin; bacteriological content was never significant. B, Another similar type of wound which had granulated within 2 weeks of therapy, during which time the staphylococci aureus and albus, and diphtheroids disappeared, but Bacillus pyocyaneus developed. Both wounds epithelized completely before patients were discharged.



	Control	14 days	27 days
Bacteriology			
Number of colonies	6,400	1,000	100
<i>Staphylococcus aureus</i>	+	+	0
<i>Bacillus pyocyaneus</i>	+	+	+
Diphtheroids	+	0	+
Area of wound—sq. cm	64.5	30.5	20.3
Treatment	Dakin's saline	755 mgm tyrothricin	1,500 mgm tyrothricin

Fig. 5. Wound separation following small bowel resection in a hypoproteinemic patient; all tissues down to peritoneum had separated and were covered with a thick purulent exudate. Within 2 weeks of treatment all exudate was cleared up and the wound was lined with healthy granulation tissue. After 27 days the wound had decreased 68 per cent in size, leaving an area of 20.3 square centimeters to be epithelized. A bactericidal effect upon *Staphylococcus aureus* was seen.



	Control	14 days	35 days
Bacteriology			
Number of colonies	57,000	125,520	38,400
<i>Staphylococcus albus</i>	+	0	0
<i>Staphylococcus aureus</i>	+	+	+
<i>Bacillus pyocyaneus</i>	0	+	+
Diphtheroids	+	0	+
Area of wound—sq. cm	37	24.5	9
Treatment	Bismuth Potassium iodide	525 mgm tyrothricin	1,450 mgm tyrothricin

Fig. 6. Two large punched-out infected ulcers of the leg of a senile female negress which were thought to be due to lues in the opinion of the dermatological consultants. No healing was seen after 3 weeks of treatment with bismuth and potassium iodide therapy. After 2 weeks of tyrothricin the punched-out areas had completely granulated in and the surrounding skin had also improved in its appearance. Thirty-five days of tyrothricin treatment produced a 75 per cent decrease in the size of the wound with only 9 square centimeters left to be epithelized. The drug was bactericidal for the *Staphylococcus albus* in this case.



	Control	25 days	Control	25 days
Bacteriology				
Number of colonies	2,200	100	505,000	150,000
<i>Staphylococcus aureus</i>	+	0	+	<100
<i>Bacillus pyocyaneus</i>	0	+	+	+(100,000)
Diphtheroids	+	+	+	+
Area of wound—sq. cm	16	15.8	80	28
Treatment	Dakin's saline	1.125 mgm. tyrothricin	Saline dressings, sulfathiazole	2,000 mgm. tyrothricin

Fig. 7. A, An infected traumatic laceration in a malnourished vagrant which had not responded to treatment with Dakin's saline solution. Twenty-five days' treatment with tyrothricin caused a complete disappearance of all necrotic tissue and exudate and complete replacement by granulation tissue. B, A decubitus ulcer due to a plaster cast which recurred several times over a period of 4 years. After 25 days' treatment with tyrothricin all necrotic tissue had disappeared in the denuded muscles and the tendons were covered by a thick layer of granulation tissue. Skin grafting was subsequently attempted but was only partially successful, presumably due to the high count of *Pseudomonas pyocyaneus*. A bacteriocidal effect upon *Staphylococcus aureus* was demonstrated in both cases.

on culture, 2,700 colonies of *Staphylococcus albus* in the right wound and 1,300 colonies of *Staphylococcus aureus* and *citreus*. The right wound was treated with tyrothricin for 35 days, after which time culture of the wound no longer contained *Staphylococcus albus*, but 1,600 colonies of *pyocyaneus* and 1,800 colonies of diphtheroids. The left wound was the control and after 35 days' culture of it showed 100 colonies of *Staphylococcus aureus*. The third case of this group was that of a secondarily infected epidermophytosis of both legs; the right leg was treated with tyrothricin and the bacteriological count, which was 200 colonies of *staphylococcus* and diphtheroids, rose to 13,000 colonies with the appearance of *pyocyaneus*. The control leg was treated with saline and the initial bacterial count of 100 colonies of *Staphylococcus aureus* rose to 1,000,000 colonies of *Staphylococcus aureus*,

*pyocyaneus*, and diphtheroids. Case 4 of this group (Fig. 17) was another with bilateral varicose ulcers. The right wound was treated with tyrothricin for 20 days and a bacteriological count of 70,000 colonies of *Staphylococcus aureus* and diphtheroids changed to 576,000 colonies of *pyocyaneus* and diphtheroids with complete disappearance of the *Staphylococcus aureus*; the left wound was treated with saline and the initial bacteriological count of 1900 colonies of *Staphylococcus aureus* and diphtheroids rose to 1,000,000 colonies of the same organisms plus *pyocyaneus*. In Case 5 with bilateral decubitus ulcers, the right wound was treated with tyrothricin for 28 days during which time the count rose from 100 colonies of *Staphylococcus albus* and *aureus* and diphtheroids to 4,200 of the same flora. The left wound, treated with saline as a control, had an initial count of 200



	Contro		14 days		21 days		35 days	
	Right	Left	Right	Left	Right	Left	Right	Left
Bacteriology								
Number of colonies	2,700	1,300	100	23,680	100	640,000	3,400	500,000
<i>Staphylococcus albus</i>	+	0	+	0	0	0	0	0
<i>Staphylococcus aureus</i>	0	+	0	+	0	<100	0	0
<i>Staphylococcus citreus</i>	0	+	0	0	0	+	+	+
<i>Bacillus pseudomonas</i>	0	0	0	+	+	+	+	+
Area of wound—sq. cm.	40	42	20	33	12	26	40	12.5
Treatment	Dakin's saline dressings	Dakin's saline dressings	700 mgm tyrothricin	Saline dressings	1000 mgm tyrothricin	Unna's paste boot	1600 mgm. tyrothricin	Saline

Fig. 8. Bilateral infected varicose ulcers of almost equal size which had not responded to Dakin's saline dressings. Right leg was selected for treatment with tyrothricin while left leg was employed as a control. Right leg showed a more rapid healing so that at the end of 35 days of treatment the right ulcer had decreased 90 per cent in size whereas the left ulcer had decreased 70 per cent. A more effective bacteriostatic influence was apparent in the tyrothricin treated wound than in the control.

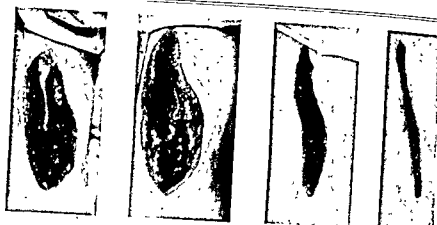
colonies of *Staphylococcus aureus* and diphtheroids, which rose to 56,000 colonies of the same organisms plus pyocyanus. The sixth case (Fig. 19) of this group was that of bilateral varicose ulcers; the right and larger wound was treated with tyrothricin for 28 days and a bacteriological count of 160,000 colonies of *Staphylococcus aureus* and hemolytic streptococcus changed to one of 1,000,000 colonies of pyocyanus with complete disappearance of the staphylococcus and streptococcus. The left ulcer was treated with Dakin's saline solution with an initial bacteriological count of 172,800 colonies of the same flora as the right wound which changed to a count of 26,000 pyocyanus and a similar disappearance of staphylococci and streptococci.

**C. Hematological.** Hematocrit determinations were made in 48 of the 77 patients treated at the beginning and at weekly intervals after treatment. The patients had received quantities of tyrothricin varying from 177.5 milligrams to 6,905 milligrams in a period varying from 7 to 48 days. Significant changes in the hematocrit (more than 3%) occurred in 14 of 48 cases studied; in the re-

mainder the hematocrit varied slightly or none at all. In 14 cases where the hematocrit changed, a rise was noted in 8 and a fall in 6. There was no relationship to dose of drug administered, period of administration, type of infection, and therapeutic result. One may deduce, at least in so far as the hematocrit is a criterion, that there was no apparent hemolysis produced in these patients as the result of tyrothricin therapy.

Hemoglobin determinations were carried out in the same series of 48 patients, and changes of 2 grams per 100 cubic centimeters or more were present in 15 patients; in 6 the hemoglobin decreased and in 9 it increased. Again there was no significance in these changes. In the main, hemoglobin changes paralleled the changes in the hematocrit.

Sedimentation rates were determined in the same series of 48 patients and recorded as millimeters per hour. In all but 1 case the initial sedimentation rate was found elevated above normal. In only 1 case did the sedimentation rate fall 10 millimeters or more whereas in 8 cases it rose 10 millimeters or more. This test, as a criteria of the treatment



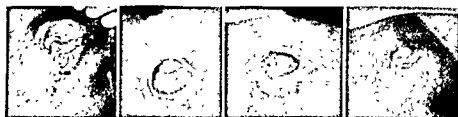
	Control	6 days	14 days	42 days
Bacteriology				
Number of colonies	24,400	700	600	0
Hemolytic streptococcus	1,200	100	100	0
Staphylococcus aureus	0	0	0	2,400
Bacillus pyocyaneus	0	0	100	0
Diphtheroids	0	0	0	6,000
Bacillus terminalis	85	67	43	14.5
Area of wound—sq cm				
Treatment	Incision and drainage	500 mgm tyrothricin	1,300 mgm tyrothricin	2,660 mgm tyrothricin

Fig. 9. Abscess of the thigh which upon incision was found to extend down between the quadriceps muscles. A 1 milligram to 1 cubic centimeter solution of tyrothricin was used here and at the end of 6 days the base of the wound was completely filled in with granulation tissue and after 42 days the area still requiring epithelization was only 17 per cent of the former size of the wound. Bacteriocidal effects were noted which were similar to those previously described.



	Control	13 days	28 days
Bacteriology			
Number of colonies	400	0	0
Hemolytic streptococcus	18,800	100	300
Staphylococcus aureus	0	0	1,500
Bacillus pyocyaneus	0	100	4,800
Diphtheroids	37.2	21.4	8.4
Area of wound—sq cm			
Treatment	Saline dressings	750 mgm tyrothricin	1,450 mgm tyrothricin

Fig. 10. Infected traumatic lacerations in a diabetic whose leg had been previously amputated at the mid-calf level. All traces of exudation had disappeared at the end of 13 days' treatment with tyrothricin, and at the end of 4 weeks a 73.9 per cent decrease in the size of the wound had resulted, leaving only an area of 8.4 square centimeters to be epithelized. A lethal effect upon hemolytic streptococci and Staphylococcus aureus was demonstrated.



	Control	14 days	29 days	55 days
Bacteriology				
Number of colonies				
Hemolytic streptococcus	5,000	0	0	0
Staphylococcus aureus	200	500	100	0
Bacillus pyocyaneus	0	100	100	400
Diphtheroids	0	100	0	600
Area of wound—sq. cm	18.5	12.5	6.6	4.3
Treatment	(8 mos.) Gentian violet, urea, sulfonamides, ultraviolet, Dakin's saline	825 mgm. tyrothricin	1,025 mgm. tyrothricin	2,775 mgm. tyrothricin

Fig. 11. This decubitus ulcer of the right hip of a 27 year old colored female failed to respond to a variety of therapeutic measures over a period of 8 months, during which time she was bedridden. Within 1 month of treatment with tyrothricin there was a clearance of all necrotic exudate and at the end of 55 days of tyrothricin treatment there was a 76.7 per cent decrease in the size of the wound and the patient was ambulant. A bacteriocidal effect upon the hemolytic streptococci and Staphylococcus aureus present in this case was demonstrated.

of the infection, was not of value within the period it was used.

Total serum proteins were studied with the objective in mind of eliminating hypoproteinemia as a factor in impaired wound healing and to follow the effect of infection upon hyperproteinemia. Eleven of 48 patients thus

studied presented an initial total serum protein of less than 6.5 grams per 100 cubic centimeters, and 3, levels more than 8.0 grams per 100 cubic centimeters; in the course of treatment the subnormal values tended to rise to normal and the elevated ones decreased. In the group of 48, a total of 6 patients showed a



	Control	7 days	14 days	22 days
Bacteriology				
Number of colonies	96,000	3,100	2,100	12,000
Nonhemolytic streptococcus	+	0	0	0
Staphylococcus aureus	+	+	0	0
Bacillus pyocyaneus	0	+	+	+
Diphtheroids	+	+	+	+
Area of wound—sq. cm.	18	16	13	4.0
Treatment	Iodoform gauze	100 mgm. tyrothricin	450 mgm. tyrothricin	675 mgm. tyrothricin

Fig. 12. Infected wound following a saphenous vein ligation. Complete disappearance of edema and exudate with reduction of the size of the wound of 77 per cent resulted from 22 days' treatment with tyrothricin. A lethal effect upon nonhemolytic streptococci and Staphylococcus aureus is to be noted whereas pyocyaneus organisms made their appearance in the course of treatment. The patient was discharged on the 22nd day.





	Control	14 days	42 days	56 days
Bacteriology				
Number of colonies	121,800	121,800	200,000	7,300
<i>Staphylococcus albus</i>	+	+	+	0
<i>Staphylococcus aureus</i>	+	+	+	0
<i>Bacillus pyocyaneus</i>	0	+	+	+
<i>Diphtheroids</i>	0	+	+	+
Area of wound—sq. cm	185	150	90	60
Treatment	Saline dressings	3,000 mgm. tyrothricin	0,600 mgm. tyrothricin	12,800 mgm. tyrothricin

Fig. 13. Marked cellulitis of the lower leg and foot of a diabetic. This lesion was treated with a stronger tyrothricin solution (1 mgm./c.c.) which resulted in a rapid disappearance of all necrotic tissue and exudate and replacement by granulation tissue. A 67 per cent decrease in the size of this large wound occurred in 56 days, at the end of which time a skin graft was successfully performed. A pronounced lethal effect upon *Staphylococcus albus* and *aureus* was noted.

drop in total serum proteins of 0.5 gram per 100 cubic centimeters, and a similar increase in 13 patients. The most marked cases of hypoproteinemia were seen in patients with overwhelming lesions such as eviscerated abdominal wounds, empyema, and cellulitis.

In 48 patients studied, the icterus index showed a rise above normal in 2 instances. One was in a patient with Buerger's disease who received 1,000 cubic centimeters of blood after a lumbar sympathectomy. The other was in a patient with an infected burn of the trunk and arms. Neither patient showed clinical signs of jaundice; nevertheless treatment was discontinued.

**D. Reactions.** Only 3 instances of reaction which could be attributed to tyrothricin treatment were seen. One was in a draining thoracotomy wound following empyema; within 24 hours after the initial introduction of 15 milligrams tyrothricin in 30 cubic centimeters of distilled water into the pleural cavity, a generalized maculopapular rash occurred which was associated with intense itching and sub-

sequent scaling. Treatment was discontinued in this case. However, 5 more chest wounds treated with tyrothricin showed no such complications. A second reaction was seen in a patient treated with 225 milligrams of tyrothricin in 450 cubic centimeters distilled water over a period of 3 days. At the end of this time the patient's leg became erythematous and warm and developed a temperature of 103.2 degrees F. This condition disappeared upon discontinuation of treatment. The third complication was seen in a patient with a huge abscess of the thigh (Fig. 9). After several weeks of treatment, a maculopapular rash developed about the wound edges. Because of the lack of subjective complaint and the excellent response in the wound, treatment was continued. The rash eventually disappeared.

#### DISCUSSION

In the selection of the type of lesion suitable for therapy with tyrothricin, the following considerations should be kept in mind: (1) Is the lesion an open wound? (2) Is there ade-



	Control	7 days	21 days
Bacteriology			
Number of colonies			
Hemolytic streptococcus	2,000	0	0
Staphylococcus aureus	6,000	37,000	5,700
Diphtheroids	0	0	400
Area of wound—sq cm	26.3	15	4.8
Treatment	Catheter drainage	300 mgm tyrothrin	900 mgm tyrr

Fig. 14. Lung abscess in a 31 year old colored female treated by thoracotomy and tyrothrin irrigations: Within 21 days the cavity was free of all exudate and lined with clean granulation tissue.

quate drainage? (3) Is there adequate circulation? (4) What is the bacteriological flora? (5) How acute is the infection?

Tyrothrin is an antibiotic which is suitable only for topical application, does not penetrate tissues, is not excreted, and depends upon maximal local concentration for its bacteriocidal effect. For these reasons, one cannot anticipate successful responses in lesions in which the source of infection does not communicate with the surface as in small fistulous tracts, undrained abscesses, unopened carbuncles, tendon sheath infections, and other infected lesions beneath the parietes. Furthermore, since tyrothrin is not indefinitely stable at room temperature and the best results are procured with frequent dressings, wounds for which it is best suited will be those which permit frequent changes of dressings or irrigations. For example, it would not lend itself well to a closed wound which is to heal by primary intention, or in the modern treatment of burns where infrequent dressings are regarded as desirable to minimize secondary infection. If a maximal local concentration of the drug must be maintained, it is apparent that the drug will be less effective when used solely as an irrigant. Herrell (9) found the material less effective in the treatment of sinusitis than in other lesions, but attributed the difference to more resistance on the part of the *Staphylococcus aureus*; however, the fact that

the drug could not be retained within the sinuses for a significant length of time also be operative. The fact that tyrothrin is hemolytic when absorbed interdicts its intrapleural injections in cases of clostridial pyemias or in peritoneal infections, for which penicillin has been recommended.



Fig. 14a. Roentgenogram of the chest after 21 days treatment indicated the disappearance of the abscess. Hemolytic streptococci were the only organisms isolated. The patient was discharged on the 21st day, completely recovered.



	Control	14 days	28 days	36 days
Bacteriology				
Number of colonies	13,000	200,000	44,000	200,000
Hemolytic streptococcus	+	+	0	0
Staphylococcus aureus	+	0	0	0
Bacillus pyocyaneus	+	+	+	+
Diphtheroids	0	+	+	+
Area of wound—sq cm	27.5	15	12	5.2
Treatment	Dakin's saline	600 mgm. tyrothricin	2,200 mgm tyrothricin	2,550 mgm tyrothricin

Fig. 15. A 57 year old diabetic who had burned himself with a hot water bottle which resulted in ulcerations, these were refractive to a large variety of therapeutic agents over a period of 3 months. The ulcer extended down to the fascia of the muscles of the leg. Satisfactory granulation of the wound began soon after tyrothricin was used, and in 36 days the patient was discharged from the hospital with a wound which had decreased 81 per cent in area. Hemolytic streptococci and Staphylococcus aureus had completely disappeared but pyocyaneus and diphtheroid organisms had increased in number.



	Control	14 days	20 days	56 days
Bacteriology				
Number of colonies	64,000	3,800	200	200
Hemolytic streptococcus	+	0	0	0
Staphylococcus aureus	+	+	+	0
Bacillus pyocyaneus	+	+	+	0
Diphtheroids	+	+	+	+
Gram anaerobe (Bacillus welchii group)	+	+	0	0
Area of wound sq cm	45	40	25	6
Treatment	Saline dressings	2,200 mgm. tyrothricin	2,125 mgm tyrothricin	4,050 mgm tyrothricin

Fig. 16. Infection of a wound following operation for a strangulated inguinal hernia requiring a bowel resection. All edema and exudate had disappeared within 2 weeks of tyrothricin treatment but it required 56 days to completely granulate and epithelize the wound. The reduction in size of the wound was 86 per cent. A bacteriocidal effect upon hemolytic streptococci, Staphylococcus aureus, Bacillus pyocyaneus, and anaerobe of the Bacillus welchii group was demonstrated.



	Control		13 days		20 days	
	Left	Right	Left	Right	Left	Right
Bacteriology						
Number of colonies	1,000	70,000	1,000,000	1,000,000	280,000	576,000
Staphylococcus aureus	+	+	+	+	+	o
Bacillus pyocyaneus	o	o	+	+	+	+
Diphtheroids	+	+	+	+	+	+
Area of wound sq. cm.	7.4	36.1	3.0	1.0	2.0	0
Treatment	None	None	Saline	550 mgm tyrothricin	Saline	800 mgm tyrothricin

Fig. 17. Bilateral stasis ulcers in a 62 year old negro female. The larger wound was treated with tyrothricin and was completely filled in by granulation tissue which required epithelization; a lethal effect upon the *Staphylococcus aureus* in this wound was shown but there was a marked increase in *Bacillus pyocyaneus* and diphtheroids. The smaller wound was treated with saline, decreased 73 per cent in size, and still contained *Staphylococcus aureus* at the end of treatment.



	Control	14 days	22 days	35 days
Bacteriology				
Number of colonies	480,000	108,000	400	64,000
Hemolytic streptococcus	+	+	o	o
Staphylococcus aureus	o	+	+	o
Bacillus pyocyaneus	o	+	+	+
Diphtheroids	o	+	+	+
Area of wound—sq. cm.	39	80	45	36
Treatment	Amputation	Débridement 2,250 mgm. tyrothricin	4,350 mgm. tyrothricin	6,200 mgm. tyrothricin

Fig. 18. Infected amputation stump treated by débridement and tyrothricin. All necrosis disappeared, the denuded muscle was covered over by granulation tissue which produced a 55 per cent decrease in the size of the wound and spared the patient the necessity for reamputation. A disappearance of hemolytic streptococci and *Staphylococcus aureus* was seen whereas *Bacillus pyocyaneus* and diphtheroid made their appearance in the course of treatment.



	Control		6 days		14 days		28 days	
	Right	Left	Right	Left	Right	Left	Right	Left
Bacteriology								
Number of colonies	160,000	172,000	1,000,000	804,000	1,000,000+	51,400	1,000,000+	26,000
Hemolytic streptococcus	+	+	+	+	0	0	0	0
Staphylococcus aureus	+	+	+	+	0	0	0	0
Bacillus pyocyaneus	0	0	+	0	+	+	+	+
Diphtheroids	0	+	+	+	0	+	0	0
Area of wound—sq. cm	21	11	22	8.0	9.5	6.1	0.1	2.5
Treatment	Heat lamp Dakin's sal	225 mgm tyrothricin	Dakin's saline	525 mgm tyrothricin	Dakin's saline		1,300 mgm tyrothricin Dakin's saline	

Fig. 19. Bilateral varicose ulcers which had been repeatedly treated over a period of years. The tyrothricin treated ulcer (right) was the larger but granulated in the same period of time as the smaller lesion. The lesions demonstrated bacteriocidal effects on the same organisms.

The surgical principles of the treatment of pus under pressure were adhered to in this study. In every instance adequate drainage or débridement was carried out; first, to avoid the destructive effects of pus under tension, and second, to increase surface contact between the medicament and the wound.

Tyrothricin was always used following such drainage and never in place of it. With the poor penetration power of tyrothricin, this principle will apply even more. Neither exudate nor necrotic tissue appeared to interfere with the action of tyrothricin; in many instances areas of necrosis were replaced by



	Control	8 days	36 days	50 days
Bacteriology				
Number of colonies				
Hemolytic streptococcus	62,800	121,600	0	0
Staphylococcus aureus	0	6,400	100	0
Bacillus pyocyaneus	1,200	0	1,200	400
Diphtheroids	0	0	1,300	500
Area of wound—sq. cm	80	75	61.5	46
Treatment	Incision and drainage	2,750 mgm tyrothricin	6,050 mgm tyrothricin	9,200 mgm tyrothricin

Fig. 20. Popliteal abscess which was treated by incision and tyrothricin dressings. The defect extended down to the muscular compartments, but in 50 days of tyrothricin treatment, all exudate had been cleared and the wound sufficiently well granulated for skin grafting. Here again a bacteriocidal effect upon hemolytic streptococci and Staphylococcus aureus was shown.

granulation tissue without the aid of débridement. Adequate blood supply was found to be

It is important to determine the bacterial flora of the lesion before proceeding with thyrothricin therapy even though most of these infected wounds contain staphylococci. The nature of the predominant bacterium found gives some prognostic information. Our results demonstrate the greater effectiveness of thyrothricin upon hemolytic streptococcus, *Staphylococcus aureus*, and the *Staphylococcus albus* in the order named, and little effect upon all others. The presence of a predominantly gram negative infection, such as pyocyanus and coliform organisms militates against the use of this drug. Finally, since the progress of the wound from a clinical point of view has been found to correlate well with the disappearance of the most pathogenic organisms, repeated bacteriological cultures would aid in checking the progress of treatment.

in a debilitated condition. Upon theoretical grounds, then, an acute infection should respond better to treatment with thyrothricin than a chronic one; this was actually found to be true. The frequency of the growth of pyo-

## CONCLUSIONS

2. Tyrothricin, when used on one of the bilateral lesions in 6 cases, produced in 5 either a more rapid rate of healing, less pain and exudate, or a greater bacteriocidal effect than was seen in the contralateral lesion.

4. Tyrothricin appeared to encourage the growth of *Bacillus pseudomonas*, *pyocyaneus*, and diphtheroid organisms.

6. Tyrothricin treatment was associated with mild skin reaction in 3 patients; these reactions disappeared when treatment was discontinued in 2 instances, and in spite of continuation of therapy in the third.

7. Tyrothricin is recommended as a non-toxic, noninjurious antibiotic agent for local use in the treatment of surgical infections, if these meet the following criteria: (a) the wound is open, (b) there is adequate surgical drainage, (c) there is adequate blood supply, (d) the predominant organisms are streptococci or staphylococci or both.

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# THE IDENTIFICATION OF CLOSTRIDIUM WELCHII IN MIXED CULTURES AND DÉBRIDED TISSUE AND DETERMINATION OF SENSITIVITY OF THE ORGANISM TO PENICILLIN

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**D**URING recent military operations in Europe, this laboratory received a large number of mixed cultures from the débrided tissue of battle wounds; the majority of these contained *Clostridium welchii*. Although the diagnosis of gas gangrene is essentially a clinical problem, Altemeier pointed out that dressings, casts, and splints make observations so difficult that gas gangrene developing under a cast may escape detection for 48 to 72 hours. Because of these difficulties a rapid bacteriological method for identifying gas gangrene organisms may be an aid in the management of contaminated wounds.

A number of rapid bacteriological methods for the identification of *Clostridium welchii* have been employed. But they have certain disadvantages for use in forward military installations. The procedures of Altemeier and Fels depend on the production of "stormy fermentation" in milk. However, Reed and Orr as well as ourselves have found a number of toxigenic strains of *Clostridium welchii* which failed to produce "stormy fermentation" under prescribed conditions. Moreover, other nonpathogenic *Clostridia* which produce "stormy fermentation" are frequently found in wounds.

Nagler and Hayward employed methods based on the splitting of insoluble fatty material in human serum by *welchii* toxin and the specific inhibition by *welchii* antitoxin. This test done on agar plates (5) appears to be quite reliable except in the presence of *Bacillus proteus* which causes a diffuse opacity thus

interfering with the reading of the opaque zone produced around the *welchii* colony by the toxin. The necessity of employing an overnight incubation period together with special anaerobic equipment and reagents renders this method impractical for forward medical installations.

Humphreys observed that his strains of *Clostridium welchii* (50 in all) produced acrolein from glycerol. Since a wide variety of common aerobes and anaerobes did not give this reaction, he suggested that this test might be considered diagnostic for *Clostridium welchii*. Although Voisenet described a gram negative bacillus isolated from water and wine in "bitter disease" (*Bacillus amaryllus*) which produced appreciable amounts of acrolein from glycerol, the incidence of this organism is rare and we have failed to encounter it in several hundred specimens from wounds. Thus the acrolein method as described by Humphreys may still be considered diagnostic for *Clostridium welchii* in cultures of wound specimens.

The production of acrolein from glycerol has been used in our laboratory as the basis for a rapid test for *Clostridium welchii*. This procedure depends upon: (1) the aerobic growth of anaerobes in a specially prepared medium; (2) the development of acidity which determines the testing time for acrolein; and (3) the testing for acrolein in the culture medium with a standardized Schiff's reagent. It is believed that this method is sufficiently simple and of short enough incubation period to be of value in forward medical installations. Since penicillin therapy is extensively used at present in gas gangrene, the procedure was appli-

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fied to include a means of determining the penicillin sensitivity of *Clostridium welchii* in mixed cultures and débrided tissue. The inhibition of acrolein by the penicillin in the medium was taken as a measure of penicillin sensitivity.

### METHODS

The methods of preparing the medium and reagents and the procedure for the detection of traces of acrolein, the production of which is specific for *Clostridium welchii*, are given in detail in the following:

#### A. Medium.

1. Mix distilled water . 970 milliliters  
Glycerine . 30 milliliters  
Tryptone (Bacto) . 20 grams  
Sodium chloride (C.P.) . 5 grams  
Agar . 2 grams
2. Heat to boiling until fully dissolved.
3. Add 5 grams ascorbic acid (C.P.)
4. Adjust to pH 6.8 with 5N NaOH (about 5.0 to 5.3 ml. is required)
5. Add 7.5 milliliters of brom cresol purple solution, prepared as follows:  
Distilled water . 99 milliliters  
N/10 NaOH . 1 milliliter  
Brom cresol purple. 100 milligrams
6. Dispense measured volumes (100 ml.) in screw capped bottles, fill almost completely so as to give the smallest surface exposure to air.
7. Sterilize in Arnold for 30 minutes on 2 successive days.
8. Final pH should be approximately 6.8  
Final Eh should be approximately -0.150 volt.
9. Add enough penicillin aseptically to some of the bottles of medium to make 1 Oxford unit per milliliter. No depreciation of penicillin potency in the medium has been observed for at least 2 weeks when it is stored in a tightly screw-capped bottle and refrigerated.
10. The medium with or without penicillin should be stored at about 5 degrees C.

#### B. Modified Schiff's reagent.

The smallest amounts of acrolein produced by *Clostridium welchii* in the glycerol medium were detected by a modified Schiff's reagent. In order to obtain consistent and reproducible results, it was necessary to standardize each batch of stock reagent against known concentrations of an aldehyde. Satisfactory results

were obtained with reagents that gave a negative test (yellow color) with formaldehyde solution (U.S.P.) diluted 1:250,000 with the medium described; a faint positive test (light pink color) with formaldehyde at 1:125,000 dilution, and a strongly positive test (deep pink color) with formaldehyde diluted 1:75,000.

The stock unstandardized solution of Schiff's reagent remained stable for a month when stored in a glass stoppered brown bottle at room temperature in the dark. This solution was prepared as follows:

0.25 gram of basic fuchsin was dissolved (by heating if necessary) in 100 milliliters of distilled water and cooled to room temperature. Small insoluble residues were discarded. Fifty milliliters of freshly prepared 4 per cent sodium sulfite and 4 milliliters of concentrated hydrochloric acid were added immediately. Distilled water was added to a total volume of 250 milliliters. After standing 5 minutes at room temperature, the solution was filtered rapidly through a large fluted filter paper.

Sensitivity of the stock solution could be affected by varying the concentration of basic fuchsin or sodium sulfite. The most satisfactory standardized solutions were obtained by determining the amount of concentrated  $H_2SO_4$  necessary to be added to stock solution to give the reactions mentioned above with the given concentrations of formaldehyde in medium. The requisite amount of sulfuric acid was determined for each batch of unstandardized reagent. Standardized stock solution was found to be unstable. It was necessary to add the required amount of concentrated  $H_2SO_4$  to stock solution sufficient only for the tests at hand.

The titration method employed for the standardization of stock reagent was as follows:

The formaldehyde-media solutions were made by the usual methods of serial dilution. One milliliter of formalin (37-40% formaldehyde U.S.P.) was pipetted into 9 milliliters of medium and thoroughly mixed. One milliliter of this solution was pipetted into 9 milliliters of medium etc. Dilutions of 1:30,000, 1:50,000, and 1:100,000 of formalin in medium were chosen. These dilutions of formalin correspond to formaldehyde concentrations of approximately 1:75,000, 1:125,000, and 1:250,000, respectively.

To adjust the stock solutions to optimum sensitivity for tests, 0.075 milliliter of concentrated  $H_2SO_4$  was added to a 10 milliliter portion of the stock solution of Schiff's reagent. One milliliter of this acidified reagent was added to 1 milliliter of each of the formaldehyde-medium dilutions and allowed to stand for 20 minutes. If this amount of sulfuric acid produced the optimum sensitivity, the 1:350,000 formaldehyde-medium dilution remained negative (yellow color); the 1:125,000 formaldehyde dilution

TABLE I.—RESULTS OF TESTS FOR THE IDENTIFICATION OF CLOSTRIDIUM WELCHII AND ITS SENSITIVITY TO PENICILLIN

Type of specimen cultured <sup>1</sup>	Number of specimens cultured	Methods of identifying <i>Clostridium welchii</i>						Other organisms present <sup>4</sup>
		Acrolein test				Nagler test <sup>2</sup>	Routine cultural methods <sup>3</sup>	
		Tube No. 1		Tube No. 2		Average No. hrs. incubated before testing	Number positive	Number <i>welchii</i> confirmed
		Plain medium	Plain medium with 1 Oxford unit Penicillin per ml					
		Number positive	Number negative	Number positive				
Mixed cultures	111 <sup>4</sup>	69	62	7	4½	69 <sup>1</sup>	69	See notes
Tissue	10 <sup>4</sup>	6	6	0	3	6	6	
Pure cultures	27	27	27	0	4	6	6	None

<sup>1</sup>Mixed cultures were secondary transplants of wound tissue cultures. Pure cultures of *Clostridium welchii* were isolated from tissue cultures and sent to laboratory for confirmation. Tissues were debrided tissue from wounds.

<sup>2</sup>Nagler test: Toxicogenic *Clostridium welchii* produce marked zones of opacity around colony on 20 per cent human serum proteose No. 3 (Bacto) agar plates which do not appear when *welchii* antitoxin is present.

<sup>3</sup>After Reed and Orr, based on cultural and biochemical characteristics.

<sup>4</sup>Combinations of 2, 3, or 4 other aerobes and anaerobes found in mixed cultures and tissue cultures.

<sup>5</sup>41 of the mixed cultures were negative for *Clostridium welchii* by all tests indicated in Table I.

<sup>6</sup>4 of the tissue cultures were negative for *Clostridium welchii* by all tests indicated in Table I.

<sup>7</sup>Includes 4 doubtful results due to presence of *Bacillus proteus* which produced diffuse opacities over entire plates.

<sup>8</sup>Organisms identified by routine cultural methods were: *Staphylococcus albus* and *aureus*; *Streptococcus hemolyticus*, also *viridans* and nonhemolytic varieties; *Bacillus proteus*; *Bacillus subtilis*; *Escherichia coli*; *Aerobacter aerogenes*; *Klebsiella friedlanderi*; diphtheroids; *Clostridium sporogenes*, *infersmentans*, *aerofetidum*, *tetanomorphum*, unidentified nonpathogenic clostridia, *oedematiens*, *septicum*, *histolyticum*, *sordellii*, *tetani*.

became pale pink, and the 1:75,000 dilution became deep pink in 20 minutes. If the 1:250,000 formaldehyde tube turned pink in 20 minutes, the reagent was too sensitive and a new trial was made using more concentrated sulfuric acid (e.g. 0.1 ml.) in 10 milliliters of stock reagent. If both the 1:250,000 dilution and the 1:125,000 dilution remained yellow, the reagent was not sensitive enough, and a smaller amount of sulfuric acid was tried (0.05 ml. conc. H<sub>2</sub>SO<sub>4</sub> to 10 ml. of stock solution).

### C. Procedure for identifying *Clostridium welchii* and determining its sensitivity to penicillin.

1. Two milliliter portions of the medium, with or without penicillin, were pipetted into sterile Wassermann tubes just before use. Two tubes were used for each specimen. Tube 1 contained the plain medium, tube 2 contained the medium with 1 Oxford unit of penicillin per milliliter. A control tube was included with each batch of tests. This consisted of uninoculated medium which was used in order to check the sensitivity of the standardized reagent used in the test.

2. Tubes 1 and 2 were inoculated with approximately the same amounts of inoculum and mixed carefully without introducing bubbles. The inoculum consisted of 5 to 10 milli-

meter pieces of freshly excised tissue, blotted free of blood, or 0.1 milliliter of mixed or pure freshly grown culture.

3. Tubes 1, 2, and the blank control were incubated *aerobically* at 37 degrees C. and observed at *hourly* intervals until sufficient growth had occurred to produce an acid reaction. The time for testing for acrolein was determined by the development of a decided yellow color in tube 1. This averaged 4 to 6 hours.

4. Following the necessary period of incubation, the tubes were centrifuged at 2500 revolutions per minute for 5 minutes. One milliliter of supernatant liquid was decanted from each tube into clean sterile tubes and labelled. One milliliter of "standardized" Schiff's reagent was added to each tube and mixed well. The tubes were shaken occasionally and observed for development of pink to purple color at the end of 20 minutes.

### RESULTS

*Clostridium welchii* were identified in mixed cultures, pure cultures, and tissue by: (a) the acrolein test described herein, (b) the Nagler

TABLE II.—RESULTS AND INTERPRETATION OF THE ACROLEIN TEST FOR *CLOSTRIDIUM WELCHII* AND ITS SENSITIVITY TO PENICILLIN

Tube No	Type of supernatant		Color <sup>1</sup> reaction with Schiff's reagent	Interpretation		
	Media	Inoculum		Presence of <i>Clostridium welchii</i>	Sensitivity to penicillin	Remarks
Control	Plain	None	Pink to purple			Reagent must be re-standardized and test repeated
			Yellow			Reagent satisfactory
1	Plain	Pure culture or mixed culture or tissue	Pink to purple	Present		
			Yellow	Absent		
2	1 Oxford unit of Penicillin per 1 ml of plain medium	Pure culture or mixed culture or tissue	Yellow	Present	Sensitive	
		Pure culture	Pink to purple	Present	Resistant	(Provided that Tube 1 is pink to purple)
		Mixed culture or tissue	Pink to purple	Present	Undetermined <sup>2</sup>	

<sup>1</sup>The presence of any shade of color from pink to purple is regarded as a positive test for acrolein, provided that the uninoculated control remains yellow during the prescribed 20 minutes

<sup>2</sup>*Clostridium welchii* may be resistant to penicillin or it may be sensitive. In the latter instance the positive acrolein reaction may be due to destruction of penicillin by other organisms present. Actual sensitivity must be determined in the above test with a pure culture.

test, and (c) routine cultural methods, as shown in Table I. All cultures of specimens which were found to contain *Clostridium welchii* by the Nagler test and the routine cultural methods gave a positive test for acrolein in the glycerol media, after approximately 4 hours' incubation. Cultures that proved to be negative for *Clostridium welchii* by the Nagler test and the routine cultural methods failed to produce acrolein in glycerol media after 24 hours' incubation. In glycerol medium containing 1 Oxford unit of penicillin per milliliter, 95 of the 102 cultures containing *Clostridium welchii* gave a negative test for acrolein. In order to correlate the inhibition of acrolein production with penicillin sensitivity, 10 pure cultures of *Clostridium welchii* obtained from the group of 95 were also tested by the filter paper disc method of Vincent and Vincent. The results obtained from these tests showed that the growth of all strains of *Clostridium welchii* tested were inhibited by the penicillin in blood agar plates. It would appear that inhibition of acrolein production could be used as an indicator of the penicillin sensitivity of *Clostridium welchii*.

Seven of the remaining mixed cultures when tested in glycerol medium containing penicillin gave a positive reaction for acrolein. However, when the pure cultures of *Clostridium welchii* from these seven mixtures were

likewise tested, they gave a negative reaction for acrolein. Furthermore these pure cultures were inhibited by 1 Oxford unit of penicillin per milliliter of blood agar (filter paper disc method of Vincent and Vincent). This positive reaction for acrolein in the mixed cultures might be explained by the presence of *Escherichia coli* or *Bacillus subtilis* either alone or in combination (See Table I). These organisms have been described as penicillinase producers by Ungar and Bondi and Dietz (2, 3). While we did not test for the production of penicillinase *per se*, these results would indicate that such substances were produced in the mixtures, destroying the penicillin in the medium and thus permitting the *Clostridium welchii* to proliferate and split the glycerine to acrolein. The inactivation of penicillin in mixed cultures by nonpathogens suggests that a similar action may occur at the wound site if contaminated with the same type of bacterial flora. It should be noted however that over 93 per cent of the mixed cultures containing *Clostridium welchii* in penicillin medium gave a negative reaction for acrolein, indicating that most of the nonpathogens encountered were probably nonpenicillinase producers.

The degree of penicillin sensitivity was further demonstrated by the following method. A pure culture of *Clostridium welchii* in chopped meat broth or Brewer's thioglycol-

late medium was tested in the same manner. As a control, the filter paper disc method of Vincent and Vincent was run. Freshly grown cultures were inoculated into portions of medium containing serial dilutions of penicillin so that the final concentrations of drug were 1 Oxford unit, 0.5, 0.25, 0.125, 0.06, 0.03, 0.015 unit per milliliter of medium. Final concentration of inoculum was 1:100. A tube of medium without penicillin was also inoculated with the same amount of culture. An uninoculated blank control was run as part of the test. All the tubes were incubated and tested for acrolein as soon as the plain medium culture had turned deep yellow. The incubation period was usually about 5 hours. The smallest concentration of penicillin which inhibited the formation of acrolein was considered as an indicator of the degree of sensitivity of the test organism to penicillin.

Tests of 10 strains of *Clostridium welchii* for relative sensitivity to penicillin by the method described showed that 1 strain was sensitive to 0.03 unit of penicillin, 3 strains were sensitive to 0.06 unit, 3 strains were sensitive to 0.12 unit, 2 strains were sensitive to 0.25 unit, and 1 strain was sensitive to 0.5 unit of penicillin. Two of the strains tested (sensitive to 0.06 unit and 0.25 unit, respectively) were retested on two other occasions with the same results. Since an extensive

series of tests have not been carried out yet, no attempt has been made to estimate the limits of experimental error in this technique.

Interpretation of the results of the test given is contained in Table II.

#### SUMMARY

1. A method is described for the identification of *Clostridium welchii* in mixed cultures, pure cultures, and wound débridement which requires no anaerobic apparatus and is completed in an average of 4 to 6 hours.

2. The test depends on the production of acrolein which in this case is considered diagnostic for *Clostridium welchii*.

3. A procedure is also given for determining the penicillin sensitivity of *Clostridium welchii* in the above types of cultures.

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## REPAIR OF VESICOVAGINAL FISTULA CAUSED BY RADIATION.

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THE cure of vesicovaginal fistulas has always excited the ingenuity and taxed the skill of the surgeon. Within this class of cases, those fistulas which are the result of radiation therapy, usually to the cervix or uterus, constitute a peculiarly difficult problem. There are several reasons for this:

First, the blood supply of the tissues locally is precarious as a result of the vascular radiation damage. Indeed, this is the main underlying cause of the fistula. Further, trauma may well produce more sloughing and any effort by the surgeon to correct the condition may end in a larger fistula and more fibrosis. Even if no actual slough occurs, healing of heavily radiated tissues is notoriously uncertain.

Second, such excessively fibrosed tissues are usually quite inelastic. This fibrosis extends for a few centimeters, at least, from the opening proper, and very often the whole area is massively affected. In methods where coaptation of the fistula edges is necessary, a recognized *sine qua non* to success is the absence of tension. Coaptation is difficult in the postradiation case and may be impossible.

Third, the fibrosis itself makes dissection very difficult, particularly if it is desired to raise several flaps for a multilayer closure. Postradiation fistulas often have very thin but very tough edges.

Fourth, one, or both, of the ureteral orifices are frequently within the fistula margin. In our cases, the left ureteral orifice was within the fistula wall in every one, and the right orifice always very near it. In such instances, to raise flaps or cut off the inner edge of the fistula would cut off at least one ureter and necessitate reimplantation of one or both ureters into a new portion of the bladder—a procedure adding greatly to the difficulty and length of the operation. Furthermore, after

heavy radiation fibrosis (and its associated infection) it may be nearly impossible to dissect up the ureter for reimplantation (as in our Case 2).

Our 3 patients all had vesicovaginal fistulas as the result of therapy for cervical cancer. All were heavily radiated with both radium and x-ray. In each instance, the upper vagina and parametrial tissues were tough and inelastic, like heavy leather. The fistula margins were thin and fibrous. One patient had been seen by various consultants for 8 years all of whom had agreed that no method of closure could succeed for the reasons just enumerated.

### DESCRIPTION OF OPERATION

Through a suprapubic incision, the space of Retzius is entered. The bladder is identified and, after the peritoneum has been pushed upward off the dome, a liberal cystotomy is carried out in the higher portions of the exposed bladder wall. The high position is chosen so that at closure the cystotomy catheter will be placed away from the symphysis, at a distance from the urethra and also from the site of the fistula repair. Closure at the desired later time occurs more rapidly with a high cystostomy than with one placed low. The interior of the bladder is exposed by retractors, and the fistula is inspected from above. Ureteral catheters are inserted since, by knowing exactly where the ureteral orifices are, damage to them can be completely avoided throughout remainder of the operation. The only sutures used in their vicinity are placed there under direct vision.

One of the assistants puts his finger in the rectum and pushes the posterior vaginal mucosa up against the fistula. A long handled scalpel with a small blade is used to mark out, transvesically, the pattern of posterior vaginal mucosa corresponding to the size, shape, and location of the fistula opening. The

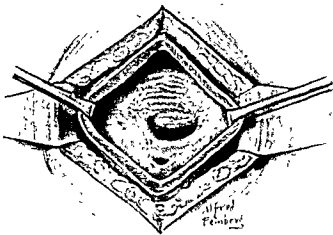


Fig. 1. Appearance through the suprapubic cystostomy.



Fig. 2. Sagittal section showing how the posterior vaginal wall is pushed up against the fistula.

ureteral catheters are left in place and sterile drapes are placed over the suprapubic wound.

The patient is now arranged in the lithotomy position and the vagina and perineum are prepared and draped. The interior of the vagina is exposed and the upper third is denuded of its mucosa by sharp dissection except that the previously outlined patch on the posterior vaginal wall is left undisturbed. Moderate bleeding is encountered, but with the exception of a few easily identified larger vessels which are ligated with plain catgut, bleeding usually ceases spontaneously, or after brief packing. The posterior third of the vagina to a point about 2 centimeters in front of the fistula is now a raw surface except the previously noted patch. The external edges of this excision are sutured together with interrupted chromic catgut transversely (parallel with the operating room floor), the anterior vaginal mucosa being sutured to the posterior mucosa at the margin of the dissection. Interrupted sutures are used so that some drainage may occur between the sutures from the fairly large raw surfaces above. No drain or vaginal packing is used.

The patient is then returned to the original dorsal position. With a long needle holder and long toothed forceps, interrupted chromic catgut sutures are placed at 1 centimeter intervals through the full thickness of the fistula margin about 0.5 centimeter from the actual edge of the opening and through the edge of

the posterior vaginal wall patch. Four to six such sutures are usually required. At the posterior edge of the opening, there is usually a small area not requiring sutures because that edge of the patch is usually continuous with the fistula edge without any pocket intervening. If such a pocket were present, the suturing would be continued all around. During this suturing, the ureteral orifices are always in complete view, and care is taken not to place sutures too close to them. These sutures are tied just tight enough to make the patch and fistula edges touch because anything more than this might injure blood supply and allow cutting through of the sutures. In this manner, the patch is accurately fitted in place to form a floor to the fistula which is only barely depressed below the general level of the bladder base.

The cystostomy is closed with a continuous plain catgut suture through all layers of the bladder wall. This suture line is then inverted with interrupted chromic catgut mattress sutures through the outer layers of the wall. A mushroom type catheter, No. 22 to 28 size, French, is placed in the highest portion of the incision. Just above the site of the catheter, a chromic catgut suture is passed through the bladder wall, avoiding the mucosa, and each end is then put through the recti and fascia at a slightly higher level. When this suspending suture is tied, during the closure of the abdominal wall, the cystostomy site is thus held

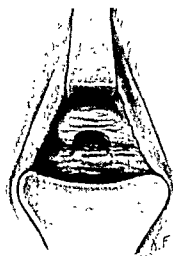


Fig. 3.

Fig. 3. Vaginal view after patch has been outlined from above.

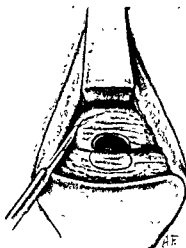


Fig. 4.

Fig. 4. Beginning removal of the vaginal mucosa.

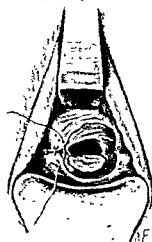


Fig. 5.

Fig. 5. Transverse closure of external margins of excision. Patch still in place. (Actually the excision of vaginal mucosa is somewhat more extensive than illustrated.)

high and against the recti. Also, some bulwark is created to hold the peritoneum away from this newly formed fistula tract. The wound is closed in routine fashion and the catheter is securely fastened to the skin with adhesive.

Upon return to bed, the patient is kept abdomen down as long as she will tolerate it, up to 10 days. The suprapubic tube is very gently irrigated with solution G<sup>1</sup> twice daily, or more often if necessary, to insure its patency—solution G decreases precipitation of urinary salts in the tube or in the suture line. Under no circumstances is this tube closed even for a short while. The addition of low pressure, "bubble", suction is, we believe, an advantage. If the patient cannot tolerate the prone position, the "bubble" suction is prob-

ly adequate if cared for. This low pressure suction is continued for over 2 weeks after operation and the patient is then placed on straight drainage for 2 days. After this, the tube is removed and voiding usually begins in a few hours. After the suprapubic area has been dry for 24 hours, the patient is discharged. During the convalescence, a daily gentle flush of the vaginal vestibule is done with a mild antiseptic. Care is taken to introduce nothing against the vaginal suture line which might

separate it. The catgut vaginal sutures, also those in bladder, come out spontaneously.

We hope that it is readily apparent from the description given that there are two suture lines plus an adhering area of raw surfaces at least 2 centimeters wide closing the fistula. The safety from damage to the ureters should be stressed. Adequate bladder drainage without a urethral catheter is of great importance, particularly during the healing period. In our cases, the uterus and cervix already were either removed or obliterated by radiation but, if there were any question of continued uterine function, a hysterectomy would be necessary before this operation could be done.

#### CASE REPORTS

**CASE I.** Mrs. A. P. No 70622. This 34 year old female first entered Memorial Hospital on May 26, 1943, with cancer of the cervix classified as League of Nations, stage II, because it extended into the left parametrium a short distance. It was freely movable, however. A biopsy showed epidermoid carcinoma, grade II.

The patient was treated by what was the routine treatment for cancer of the cervix at that time. This consisted of roentgen therapy, 250 r to a large 14 by 19 centimeter anterior port the first day, a similar treatment to a 14 by 19 centimeter posterior port the second day, and two treatments of 250 r each to 14 by 11 centimeter right and left lateral ports the third day. The cycle was repeated until each port had received 1750 r. The factors were 200 kilovolts, peak;

<sup>1</sup>Citric acid (monohydrous)  
Magnesium oxide (anhydrous)  
Sodium carbonate (anhydrous)  
Distilled water ad

33 3 gm.  
3 8 gm.  
4 4 gm.  
1000 cc (10)

0.5 millimeter copper filter, 70 centimeter target skin distance, 30 milliamperes. On conclusion of the external roentgen therapy, treatment was given to the cervix through vaginal cones. This consisted of 4 treatments of 500 r each through a 4 centimeter cone to the cervix direct and 4 treatments of 750 r each to each fornix through 3.5 centimeter cones. One treatment was given daily. The factors were 130 kilovolts, peak; 0.25 millimeter brass filtration, and 35 centimeter target skin distance, 5 milliamperes.

Twelve days after this treatment was finished, a 6 centimeter plastic applicator containing 104 millicuries of radon was inserted into the cervix for a dose of 3600 millicuries hours. The filtration was 0.5 millimeter platinum plus the wall thickness (1 mm.) of the plastic applicator. Unfortunately, this was not sufficient to control the cancer, for 2 months after the insertion of the radium persistence or recurrence was noted and confirmed by biopsy.

On October 22, 1943, a "stem and base" radium applicator was applied for 1000 millicuries hours, all the radon being in the base. Also, a single capsule was packed into left vault for 750 millicuries hours.

In spite of this treatment, a biopsy on January 3, 1944, showed active cancer. The cervix was still somewhat movable and the parametria were still not widely invaded with carcinoma. On February 4, 1944, a radical Wertheim hysterectomy was done. Operation was rendered difficult by the edema and fibrosis in the bases of both broad ligaments and between the trigone and vagina. Great care was taken to cause as little trauma as possible to the base of the bladder.

Postoperatively, a pack of zinc peroxide was placed daily against the suture line closing the vagina. In spite of this care, the upper vagina parted and a large cavity lined with necrotic tissue appeared in the area previously occupied by the uterus. The cavity slowly cleaned up and decreased in size, but the base of the bladder remained white. A small rectovaginal fistula appeared and then healed spontaneously. Two months after the radical hysterectomy, the white area in the bladder trigone separated, and the patient developed a large vesicovaginal fistula. It was so large that the index finger could be introduced with ease into the bladder through it.

The fistula was observed at frequent intervals from then on and various plans devised to try to diminish the leakage. A rubber condom was packed with cotton and inserted daily by the patient to try to stop the leak mechanically. This did not help. A contraceptive pessary was fitted to try to occlude the opening, again without improvement.

Thirteen months after the radical hysterectomy and 11 months after development of the vesicovaginal fistula, after three biopsies from the edge of the fistula had shown no carcinoma, the above described operation was carried out on March 1, 1945. The patient was kept flat on her abdomen in bed for 2 weeks, then gradually allowed to resume normal activities. A little urine leaked from the

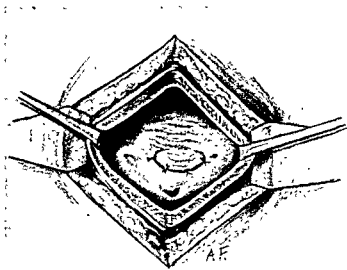


Fig. 6. Cystotomy view showing fistula edges sutured to patch.

vagina postoperatively on one or two occasions when the suprapubic tube was kinked or plugged.

She was discharged from the hospital 3 weeks after operation and has remained dry and free of any evidence of cancer since (8 months). Urinary control is normal. The result of the operation was a matter of intense joy and satisfaction to the patient. Repeated cystoscopic examinations clearly showed the patch of vaginal mucosa and on two occasions, thin, friable, white concretions were seen on its surface and scraped away with biopsy rongeurs.

The patient has had repeated sexual intercourse since her operation and, in spite of the shortening of the vagina which measures little more than 5 centimeters in length, reports satisfaction both to herself and husband after some adjustment.

Intravenous pyelograms made before the radical hysterectomy showed no hydronephrosis. After operation, they showed considerable hydronephrosis, most marked on the right side. This gradually diminished over the next month. Unfortunately no pyelogram was made immediately before the plastic closure of the fistula, but a recent intravenous pyelogram 8 months after this operation shows normal kidney function and no dilatation of the ureters.

CASE 2. Mrs. E. B. No. 52286. This 31 year old patient first entered Memorial Hospital on September 17, 1936, complaining of a foul-smelling, watery vaginal discharge first noticed 6 months previously during her third pregnancy. Examination revealed a large fungating carcinoma of the cervix, graded II on biopsy. It did not extend into the parametria and was classified as League of Nations stage I.

She was treated with external roentgen therapy to six 10 by 14 centimeters pelvic ports from September 21, 1936, to October 10, 1936, each port receiving first 100 r, then 150 r, 200 r, 250 r, 300 r and 350 r, for 1350 r per port. The factors were 200 kilovolt peak, 0.5 millimeter copper filter, 70 centimeter target skin distance, and 30 milliamperes. On October 26,



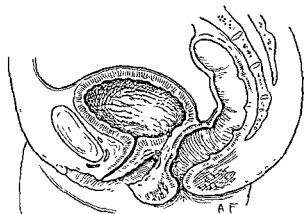


Fig. 7 Sagittal section showing end result. (Cystostomy tube not illustrated.)

radium in a vaginal applicator (bomb) was placed against the cervix for 1500 millicuries hours. The next day a radium tandem was inserted into the cervical canal for 3000 millicuries hours. The filtration of both of these applicators was the equivalent of 0.5 millimeter of platinum.

On subsequent follow-up visits, it was noted that fluid accumulated inside the uterine cavity which gradually became purulent and foul. Dilatation of the cervix failed to provide adequate drainage and she became chronically ill by the prolonged sepsis.

Finally, as a palliative procedure on February 27, 1937, 4 months after radium treatment, a supra-cervical hysterectomy was performed, the dilated fundus which by then was a very foul sac of pus, being removed. During the operation, an attempt was made to dissect the base of the bladder off the cervix but this was abandoned because of the edema and fibrosis encountered. Most of the cervix was left *in situ*, a cigarette drain being passed down through its center into the vagina. No cancer was found in the operative specimen.

Postoperatively, a large abscess formed in the posterior cul-de-sac which began to discharge through the cervix a month after operation.

In May, 1937, she was hospitalized elsewhere because of acute abdominal pain, dysuria, and gross hematuria. While there, she had an acute vaginal hemorrhage and developed both rectovaginal and vesicovaginal fistulas. From then on, her general condition began to improve greatly so that in November, 1937, it was noted she looked well and had no complaint save for constant leakage of urine.

She was seen at frequent intervals in the follow-up clinic without developing any sign of recurrence of the cancer. Save for occasional bouts of cystitis, with some bleeding at times, she remained well. Frequent consultations were held as to the possibility of closing the fistulas, but it was generally agreed that any procedure toward this end was not feasible.

Finally in September, 1945, 8 years after the fistulas developed and after we had seen the success which attended the operative treatment of our first

case, she was admitted again with the hope of performing a similar procedure.

Examination showed as in the first case a fistula on the anterior wall of the vagina at its apex through which the tip of the index finger could be inserted into the bladder. Introduction of methylene blue into the rectum showed it to pour out through the same opening. A barium enema done under fluoroscopic guidance with a thin barium solution showed this fistulous opening communicating with the mid-sigmoid. Intravenous pyelograms demonstrated a left hydronephrosis and hydroureter.

On September 13, 1945, the patient was operated upon as here described. Two observations should be made on this procedure; first, that it was necessary to open the abdomen and disconnect the sigmoid from the base of the bladder. The fistulous tract was turned in and closed by three layers of sutures in the wall of the bowel. The bladder defect could not be so treated because of the extensive fibrosis and consequently it was closed with interrupted sutures placed on the posterior side (i.e. in the cul de-sac). The cervix was not seen.

The second point of note was that there was hydroureter of the left ureter which emptied through a tiny opening into the left lateral wall of the fistula. This opening could not be dilated sufficiently to allow the introduction of a fine probe or of a ureteral catheter and consequently only the right ureter was catheterized. An attempt was made to dissect the left ureter free and reimplant it in the bladder. There was such marked radiation fibrosis of the ureter all along its course in the pelvis that it could not be separated safely, and the attempt was abandoned.

The patient was kept on her abdomen for 8 days after operation. When she was allowed to turn on her back after that time, urine began to leak through the vagina. Finally with the help of constant gentle suction on the suprapubic cystostomy tube, she was kept dry and healed solidly. A brief febrile episode, due to left pyelonephritis, cleared with penicillin therapy. She was discharged from the hospital on the thirty-eighth postoperative day.

Since then she has remained well and completely dry with normal control of urine. The vagina is 6 centimeters deep and completely healed. Cystoscopic examination shows the patch to be covered by a small amount of white, easily removed exudate. Intravenous pyelogram shows no change compared with the examination before operation. The patient has had sexual intercourse since operation.

CASE 3. M. C. No. 72338. This 45 year old patient first entered Memorial Hospital on November 26, 1943, with cancer of the cervix classified as League of Nations, stage III, because it extended in the left parametrium to the pelvic wall with fixation on that side.

She had been treated at another hospital on March 21, 1943, with 2000 millicuries hours of radium in 2 capsules inserted into the cervical canal. This was repeated on May 9. In October, vaginal bleeding recurred and at the same hospital on October 24,

2000 millicuries hours of radium was administered for the third time.

Since a biopsy on admission to Memorial Hospital showed epidermoid carcinoma, grade II, roentgen therapy was begun on December 3 and continued until January 4, during which time each of six 14 by 11 centimeters pelvic ports received 250 r times 8, or 2000 r. The factors were 200 kilovolt peak, 0.5 millimeter copper filter, 70 centimeter target skin distance, and 30 milliamperes. On January 13, 1944, a vaginal bomb was placed against the cervix for 1500 millicuries hours. On January 14, a radium tandem was inserted into the cervical canal for 3000 millicuries hours.

Three months later it was noted that the cervix had been replaced by a large crater filled with foul-smelling slough.

On January 31, 1945, a year after her last radium treatment, a large vesicovaginal fistula at the upper end of the vagina was seen but all evidence of cancer had disappeared save for thickening and scarring in the left parametrium. She complained of complete urinary incontinence. Biopsies from the edge of the fistula showed no evidence of cancer.

Consequently, on September 27, 1945, a year and 9 months after the last radium treatment, the fistula was repaired by the technique already described. The left ureter, as in the other 2 cases, was found opening into the margin of the defect, but no evidence of hydronephrosis or hydroureter could be demonstrated by intravenous pyelography preoperatively. The operation was somewhat easier than those in the other 2 cases because the tissues of the bladder and vagina were more elastic and had a better circulation. The uterus was still present. A hysterectomy had not preceded the fistula repair but the uterine canal and cervix had been completely destroyed by the radium she had received.

Postoperative convalescence was uneventful and no urine came from the vagina at any time. She was allowed out of bed on the fifteenth postoperative day. The suprapubic catheter was removed on the seventeenth day. She was discharged dry, with complete urinary control on the twenty-third day after operation.

A month and a half later, cystoscopy showed the patch of vaginal mucosa in the base of the bladder to be clean, pale and not inflamed. The vagina was about 4 centimeters in length and the patient reported that she had had sexual relations satisfactorily without discomfort. Intravenous pyelograms showed that both kidneys excreted the dye at 5 minutes. There was no evidence of obstruction in either ureter. There were still some thickening and scarring felt by rectum in the base of the left broad ligament, but the clinical opinion was that this represented radiation fibrosis and not recurrent cancer.

#### DISCUSSION

This method of closure was devised without reference to published articles on the subject

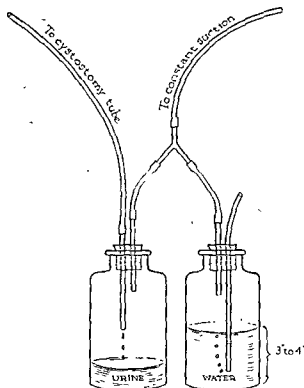


Fig. 8. Diagram of low pressure, "bubble," suction drainage.

but, as commonly happens, we now find that many of its individual features have been used and described before. However, the plan of attack as a whole seems original. Such time-honored principles as lack of tension, preservation of blood supply, separated suture lines and a wide area of coapted raw surfaces are included. The operation of colpocleisis, partial or total, is old but is at times still advised (1, 2, 3, 4, 5, 6). It was devised first by Gustav Simon, of Darmstadt, in 1855 and later by Dr. Nathan Bozeman, of New York. Simon's operation of colpocleisis left the uterus emptying into the bladder and also left a dependent diverticulum in the bladder floor. Cystitis and calculus formation were common sequelae. Latzko improved this operation and incidence of these sequelae are less in his hands.

Our operation does not leave the uterus emptying into the bladder at all since the uterus has been removed or destroyed by radium, nor does a diverticulum result. Thus far no calculi have formed, the patients have not been troubled with cystitis symptoms after the immediate postoperative period, and repeated cystoscopic check-ups have found a steady diminution in the inflammatory re-

action about the patch site. Complete obliteration of the vagina may be necessary rarely but has the objection of excluding normal sexual activity—not uncommonly an important item with these patients. The partial obliteration resulting from our procedure has in each instance left a vagina of 4 to 6 centimeters in length and all patients have had sexual relations since operation, though some adjustment was necessary.

The idea of using a patch of tissue from the posterior vaginal wall is also by no means new. Trendelenburg, in 1890, described a two stage operation on the pedicle graft principle to transfer a patch from the posterior vaginal wall to cover the fistula in the anterior wall. J. R. Miller in the discussion of another paper mentioned a case with a "blowout patch" of vaginal mucous membrane closing the fistula. This operation by Miller was very nearly like ours but apparently the suprapubic approach was not used. Witzel described the use of a patch of mucosa from the posterior vaginal wall sewed into the fistulous opening but did not accompany this by partial colpocleisis. The suprapubic approach has been described and perfected many times since Trendelenburg first advocated it in 1890. Catheterization of the ureters during operation is, of course, not original. In this connection, it might be well to remember that the only patient operated upon in London by the famous J. Marion Sims died because the ureters were included in the sutures (8). Various methods, including cystostomy, have been used to provide adequate drainage postoperatively. The indwelling urethral catheter rests on the newly repaired area and always sets up some urethral inflammation, but a well placed and cared for cystostomy tube does neither of these. Many plans for constant emptying of the bladder have been devised but the prone position and the low pressure, "bubble" suction seem the most efficient to us. The continuous prone position becomes a hardship to the patient and may allow the suprapubic tube to kink without the nurse's knowledge. However, it is simple and to the point. Low pressure suction is more comfortable but the apparatus requires constant attention and

does not prevent slight leakage through the repaired area, particularly for the most important first few postoperative days.

#### SUMMARY

Repair of vesicovaginal fistulas in heavily irradiated tissues is peculiarly difficult because the local blood supply is precarious, the tissues are inelastic and fixed, and the tissues are so fibrotic as to make dissection, particularly of flaps, quite difficult. Also the frequent intimate association of the ureteral orifices adds to the problem greatly.

The plan described is to be used only where residual cancer is ruled out, where the uterus and cervix are removed, or clearly obliterated, and where the urinary status after fistula closure would be expected to be satisfactory (especially good sphincter control). Sexual activity after operation is possible.

The operation is a combined transvesical and vaginal approach which permits complete safety to the ureteral orifices in or near the opening; a two suture line closure with these lines separated by at least a 2 centimeter adhering area of raw surfaces; a minimum damage to blood supply; closure without tension; relatively simple and easy dissection; and adequate bladder drainage during the postoperative period without a foreign body irritating the newly repaired area.

Postoperative care is directed toward continuous gentle bladder drainage and cleanliness of the wounds.

Only 3 cases are reported but the successful result in each, considering the unfavorable preoperative condition, seems to indicate the value of the method.

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# MANDIBULAR TUMORS

## A Clinical, Roentgenographic, and Histopathologic Study

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THE diagnosis of ameloblastoma (adamantinoma) of the mandible has been made frequently by use of only the roentgenogram. The multilocular appearance in the roentgenogram is supposed by some to be characteristic of the ameloblastomas. It is the purpose of this report to demonstrate that (1) many jaw tumors can produce a similar roentgenographic picture, and (2) ameloblastomas have not a constant characteristic roentgenographic picture. Consequently the roentgenogram alone cannot be depended upon for a diagnosis of ameloblastoma or of any other type of jaw tumor.

### CASE REPORTS

The following series of 12 case reports including roentgenograms and photomicrographs has been carefully selected principally from our office and hospital files on mandibular tumors. The pertinent findings are summarized in Table I. The series has been divided into two groups.

- I. Ameloblastomas with varying roentgenographic findings.
  - A. Roentgenogram "typical" of ameloblastoma.
  - B. Roentgenogram similar to that of a dentigerous cyst.
  - C. Roentgenogram similar to that of a retained root fragment and cyst.
  - D. Roentgenogram similar to that of an invasive tumor of bone.
- II. Benign and malignant tumors (other than the ameloblastoma) which appear multilocular on the roentgenogram.
  - A. Multiple follicular cyst.
  - B. Giant cell tumor (local).
  - C. Giant cell tumor (general). Hyperparathyroidism.
  - D. Fibroma.
  - E. Fibrosarcoma.
  - F. Osteogenic sarcoma.
  - G. Metastatic carcinoma from the breast.
  - H. Metastatic carcinoma from the thyroid.

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### *Ameloblastomas with Varying Roentgenographic Findings*

*Roentgenogram "typical" of ameloblastoma.* C.E.S., white male, aged 71 years, was first seen on October 11, 1940. Several years before, the patient noticed the left side of his jaw was enlarged. Physical examination revealed a hard nonmovable mass which extended from one centimeter below the zygomatic process to the lower border of the ramus. Intraoral examination revealed a fistula in the region of the lower left third molar. On October 12, 1940, through an intraoral incision a large cyst was removed from the left mandible at the angle. Iodoform and balsam of Peru pack was inserted. The tissue on cut section was white, fibrous, rather firm, and not characteristic. The microscopic diagnosis was ameloblastoma (Fig. 1 a).

The patient was next seen on December 2, 1941, and complained that 3 months before the jaw began to swell at the left angle again. Some pain which was not very severe was present. The patient was operated upon December 3, 1941, and because the ameloblastoma had "recurred," causing a pathological fracture of the mandible, and because the tumor was no longer contained within the mandible but invading the surrounding tissue, cautery destruction of the growth was done.

*Roentgenogram similar to that of a dentigerous cyst.* B.J.B., white female, aged 17 years, was first seen on February 12, 1945. Patient stated that she had a "gum boil" at the back of the left jaw for the previous 6 weeks. Physical examination revealed a soft tissue mass in the left retromolar area which was 0.5 centimeter in diameter. The mass was neither tender nor movable. There was a moderate expansion of the body of the mandible in this area. On March 8, 1945, an incision was made in the retromolar area, the mucoperiosteum was reflected laterally and the lingual nerve was preserved. An entrance was gained to the cyst cavity by removal of the thin plate of bone. There was considerable solid material which was removed completely from the cyst wall. The cavity was packed with iodoform gauze. Histopathologic diagnosis was ameloblastoma (Fig. 1 b).

*Roentgenogram similar to that of a retained root fragment and cyst.* F.M.A., white male, aged 40 years, was first seen March 29, 1938. Patient first noticed a lump in the right mandible about 1 centimeter in diameter, 6 weeks before while shaving. There was no pain. There had been drainage into the mouth from the region of the mass for 1 week.

**SURGERY, GYNECOLOGY AND OBSTETRICS**  
**TABLE I.—CHARACTERISTICS OF MANDIBULAR TUMORS WHICH APPEAR MULTILOCULAR**  
**ON THE ROENTGENOGRAM**

Histopathologic diagnosis of various cases	Age when seen years	Clinical history	Clinical findings	Location in mandible	Edentulous areas	Miscellaneous
I A Ameloblastoma See Fig 1 a	71	Several years ago left side of mandible enlarged. Discharge from molar area 6 months ago. Reoperated upon 14 months later	Hard, nonmovable mass extending from 1 cm below zygoma to lower border of ramus	Angle and ramus	Complete mandible	Pathologic fracture—subsequently
I B Ameloblastoma See Fig 1 b	17	"Gum boil" behind last tooth of mandible 6 weeks	0.5 cm mass, retromolar area, moderate expansion of mandible	Angle and most of ramus	None	
I C Ameloblastoma-odontome See Figs 1 c & e	40	1 cm lump back part of mandible noticed 6 weeks previously while shaving	Firm, fixed, nontender, 5 cm mass extending from mental foramen to angle	Molar area	Involved area	
II A Multiple follicular cyst See Fig 2	45	Pain in jaw 8 months. Lower teeth extracted 7 months ago, swelling of jaw and discharge 3 weeks	Moderate enlargement of mandible from angle to cuspid area. Draining sinus molar left area	Molar area, angle, and ramus	Complete mandible	Bilateral involvement of mandible
II B Giant cell tumor (focal) See Fig 3	13	Painless, progressive swelling both sides of mandible for 6 years	Both rami of mandible enlarged and irregular	Everything posterior to bicuspid area except condyle	Involved area	Blood serum calcium and phosphorus within normal limits. Bilateral involvement of mandible
II C Giant cell tumor (hyperparathyroidism) See Fig 4	40	Painful jaw 13 years, all teeth extracted 4 years ago. Four weeks ago mandible began to swell	Smooth, sharply outlined tumor which extended half-ramus 1 cm mass in maxilla near ala of nose. 3 x 1 gland	Angle	Complete mandible	Preoperative: Bl S Ca, 14.6 mgm % Bl S P, 3.4 mgm % Postoperative: Bl S Ca, 9.3 mgm % Bl S P, 3.1 mgm %
II D Fibroma See Fig 5	15	Swelling of jaw, 4 months sharp shooting pains to ear jaw. Dentist stated trouble caused by erupting wisdom tooth	Firm, fixed, nontender mass in parotid region and extended to angle of jaw	Angle and ramus	None	
II E Fibrosarcoma See Fig 6	4	Intermittent toothache for 8 weeks, rapid swelling of face and mandible, 6 weeks of dentist and otolaryngologist found nothing wrong Sulfamidamide prescribed	Large, hard mass which extended from lower border of ear	Molar area and everything posterior	Involved area	
II F Osteogenic sarcoma See Fig 7	20	Swelling of mandible, months. Diagnosis of impacted wisdom tooth which not healed. Wound did	Diffuse, firm swelling at angle of jaw. Surrounding tissue indurated. Unable to open mouth	Molar area, angle and ramus	None	
II G Metastatic carcinoma from breast See Fig 8	57	Numbness and tingling of lower lip and lump in mandible 6 months. Molar area extracted and 8 deep x-ray therapy treatments with no relief. Diagnosis of carcinoma of breast 1956	Nontender, round, hard mass, 1.5 cm in diameter in about molar region	Molar area	Involved area	
II H Metastatic carcinoma from thyroid See Fig 9	55	Dull pain in mandible 5 weeks	Resilient mass, lingual pre molar region, of mandible. Stoney hard diffuse enlargement of right lobe of thyroid gland	Bicuspid area	Complete mandible	Tumor also metastasized to right iliac crest

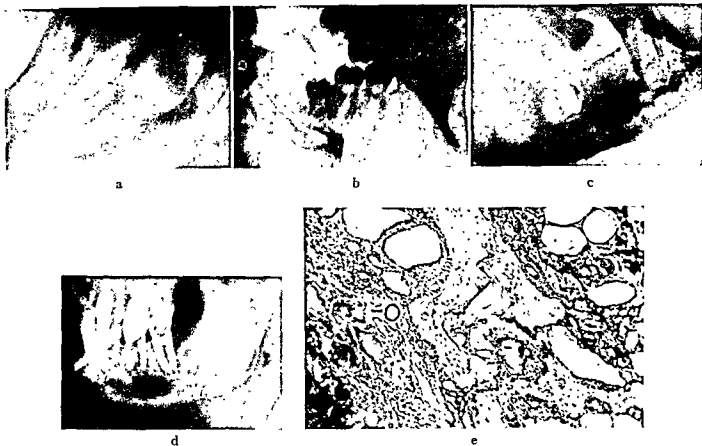


Fig. 1. Roentgenograms illustrating the various patterns which the ameloblastoma may assume: a, "typical" of an ameloblastoma; b, similar to that of a dentigerous cyst; c, similar to that of a retained root fragment and cyst (a and c from Byars and Sarnat, *Surg. Gyn. Obst.*, 1945, 81: 575); d, ameloblastoma with infiltrating characteristics (courtesy of C. V. Mosby Co., St. Louis, Mo. From Thoma, *Oral Pathology*, Fig. 937 A, 2d ed., 1944);

e, photomicrograph obtained from specimen in Case I C. Note the columnar cells arranged in a palisade formation. In the center of these areas there appears to be a clear cytoplasm, the margins of which cannot be determined because of the fine reticulum. There is a moderate amount of dense connective tissue stroma between the groups of tumor cells. Note areas of osteodentin, O. Diagnosis: ameloblastoma—odontome (Fig. 1c).

Physical examination revealed no teeth in the lower right jaw and a firmly fixed nontender mass about 5 centimeters in diameter, extending from about the mental foramen to the angle. On March 31, 1938, patient had a resection of the mandible. Surgical specimen consisted of a round, firm tumor attached to a portion of the mandible. When cut, there was a very distinctly gritty sensation to the knife. The cut surface presented a very cellular appearance. The histopathologic diagnosis was ameloblastoma and odontoma (Figs. 1 c and e).

Patient was seen in April of 1940 and there was no evidence of recurrence. In August, 1944, the patient wrote that jaw has never given him any trouble.

Roentgenogram similar to that of an invasive tumor of bone. Figure 1 d is an illustration of an ameloblastoma similar to that of an invasive tumor of bone.

#### *Benign and Malignant Tumors (Other Than the Ameloblastoma) Which Appear Multilocular on the Roentgenogram*

**Multiple follicular cyst.** J.W.J., white male, aged 45 years, was first seen November 27, 1942. Patient

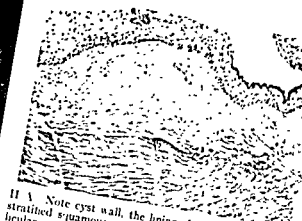
complained of pain in the lower jaw since about March, 1942. In April of 1942 he had all of his lower teeth extracted. There had been a foul taste in the mouth for the previous 6 months. In early November he noticed a swelling in the left lower jaw and since that time there had been a discharge of grayish material. Physical examination revealed a fistula in the lower left molar area. On November 28, 1942, through an intraoral approach the cysts of the mandible were excised bilaterally. The cyst wall was white, thin, but firm. The inner wall of the cyst was glistening and the cyst contained fine brown, friable material. The histopathologic diagnosis was multiple follicular cyst (Fig. 2).

**Giant cell tumor (local).** B.A.L., white female, aged 13 years, was first seen on April 15, 1942. About 6 years before patient noticed swelling of both sides of the face unaccompanied by pain. From 1936 to 1938 patient had 8 operations on the mandible. There was no similar condition in any other member of the family. Examination revealed that both rami of the mandible were enlarged and irregular, but normal in dimension in the long axis. On July 8, 1942, there were the following laboratory findings:

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Fig. 2. a, left, Lateral roentgenogram of mandible. The histopathologic diagnosis is multiple follicular cyst (Fig. 2b). b, Photomicrograph of specimen obtained from Case



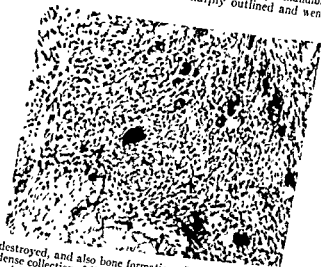
II A. Note cyst wall, the lining of which is made up of stratified squamous epithelium. Diagnosis: Multiple follicular cyst (Fig. 2a). X70.

blood serum calcium, 11.1 milligrams per cent, blood serum phosphorus, 4.9 milligrams per cent, blood serum phosphatase, 9.4 Bodansky units.

(On July 9, 1942, an incision was made on the left side of the neck in the fold from the side of the thyroid cartilage to the base of the ear. This flap was dissected upward exposing the right side of the mandible on the outer plate of which was a hard, raised, bluish discoloration. The outer plate was removed by chisel and a tumor mass exposed, which ran throughout the anterior two-thirds of the mandible on its right side. The tumor was removed by curettage and chisel, but due to its numerous ramifications in the bone, it was highly improbable that all the cells were removed completely. The tumor was fragmented, fairly firm yellowish-gray. The cavity in the mandible was packed with iodoform gauze led through the soft tissues to the exterior. The histopathologic diagnosis was giant cell tumor

(Fig. 3). Roentgenograms taken periodically have shown regression of the tumor area. There was no recurrence up to March, 1945.

*Giant cell tumor (general), hyperparathyroidism.* L. C. C., white female (general), aged 45 years, was first seen on March 26, 1941. Patient stated that she had an abdominal operation in 1928 and since that time the right side of her jaw had been sore. Two years later two teeth were extracted and the jaw condition became worse. About this time patient began to have attacks of vomiting which continued for 11 months when she was operated upon for a floating kidney without any subsequent relief. About 2 years before, patient experienced severe pain in jaw and thought something broke. Because of weakness she was suspected of having tuberculosis. Four weeks previously the right side of the jaw began to swell. Examination revealed a tumor of the right mandible which was smooth and sharply outlined and well



destroyed, and also bone formation. In addition note the dense collection of fibroblastic cells in which there are many multinucleated giant cells. Diagnosis: giant cell tumor of mandible (Fig. 3a). X70.

Fig. 3. a, left, Lateral roentgenogram of mandible. The histopathologic diagnosis is giant cell tumor (Fig. 3b). b, Photomicrograph of specimen obtained from Case II B. Note bone the margins of which are irregular and are being



Fig. 4. a, left, Lateral roentgenogram of the mandible. The histopathologic diagnosis is giant cell tumor. The patient had a parathyroid adenoma (Fig. 4 b). b, Photomicrograph of specimen obtained from Case II C. Note the



fibrous connective tissue which contains an enormous number of multinucleated giant cells. Diagnosis: giant cell tumor of mandible (Fig. 4 a). (Also see Table I and contrast with Case II B).  $\times 125$ .

halfway up on the anterior border of the ramus. There was a distinct swelling 1 centimeter wide at the level of the nose near the ala. There was a tender 3 by 1 centimeter node on the right side in the region of the thyroid gland. At laboratory examination the following findings were revealed: blood serum calcium, 14.6 milligrams per cent; blood serum phosphorus, 2.4 milligrams per cent; blood serum phosphatase, 11.8 Bodansky units.

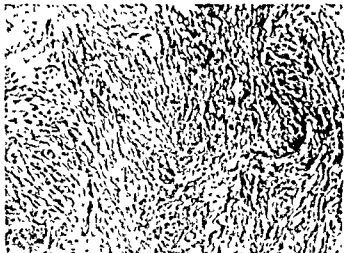
On March 27, 1941, tumors were removed from both upper and lower jaws on the right side. Following this a parathyroid tumor was removed deep to the lower pole of the thyroid on the right. The jaw material consisted of several small pieces of irregularly shaped brownish friable tissue. The histopathologic diagnosis was giant cell tumor (Fig. 4). Laboratory findings on the seventh postoperative day revealed the following: blood serum calcium, 9.2

milligrams per cent; blood serum phosphorus, 5.1 milligrams per cent. On October 9, 1944, patient stated that she felt perfectly all right.

*Fibroma.* L.C.H., white female, aged 15 years, was first seen on December 1, 1944. Patient complained of swelling of the right jaw since August, 1944. At that time a dentist said that a wisdom tooth was erupting. The growth had increased in size somewhat since and there had been sharp shooting pains in the right ear, in addition to some disability in the use of the jaw. Two weeks before a physician took a roentgenogram and told her the mass was attached to the bone. Physical examination revealed a visible lump in the right parotid region. It was firm, not movable, and not tender, and extended to the angle of the jaw. There was some limitation of movement of the jaw. The teeth were in good condition.



Fig. 5. a, left, Lateral roentgenogram of the mandible. The histopathologic diagnosis is fibroma (Fig. 5 b). b, Photomicrograph of specimen obtained from Case II D.



The tumor is an acellular collagenous fibroma of bone the cell origin of which is indeterminate. Diagnosis: fibroma (Fig. 5a).  $\times 125$ .



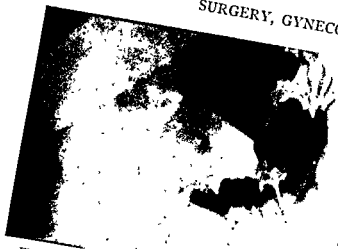


Fig. 6 a, left, Lateral roentgenogram of mandible. The histopathologic diagnosis is fibrosarcoma (Fig. 6 b). b, Photomicrograph of specimen from Case II E. The tumor is extremely cellular. The individual cells are spindle

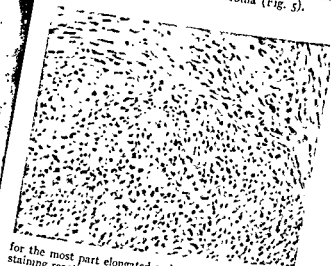
shaped to rounded, the nuclei are variable in size, shape, and staining reaction; many are hyperchromatic; numerous mitotic figures seen. This is a rapidly growing neoplasm of fibroblastic origin. Diagnosis fibrosarcoma (Fig. 6a). X125

On December 2, 1944, an incision was made from below the lobe of the right ear forward under the mandible to below the lateral incisor region. Skin, subcutaneous tissue, platysma, lower pole of the parotid and tissue superficial to submaxillary salivary gland were all turned upward to expose the angle and body of the mandible. The masseter muscle was dissected free from the ramus, exposing the entire ramus and angle which were involved by the tumor. The mandible was sectioned at the last molar tooth. The ramus was disarticulated and removed. Another half inch of bone was removed from the forward fragment because it was questionable

whether the tumor had been encroached upon at the point of section. The jaws were wired in occlusion. The surgical specimen consisted of the right ramus of the mandible which was surrounded and permeated by a firm, resilient, nonfriable white tumor mass. The specimen cut with increased resistance and showed a thin white capsule which completely surrounded the tumor mass. The cut surface of the mass was yellow with streaks of white tissue running through it. It showed some evidence of hemorrhage but no cystic changes grossly. The tumor was growing on both sides of the mandible, which was thin and showed evidence of bone destruction. The histopathologic diagnosis was fibroma (Fig. 5).



Fig. 7 a, left, Lateral roentgenogram of mandible. The histopathologic diagnosis is osteogenic sarcoma (Fig. 7 b). b, Photomicrograph of specimen obtained from Case II F. Note thick layer of fibrous tissue which is growing without any plan. The cell outlines are not sharp. The nuclei are



for the most part elongated and vary in size, shape, and staining reaction. An occasional mitotic figure is seen. In other areas abnormal bone formation is seen. Diagnosis osteogenic sarcoma from membranous bone (Fig. 7 a). X125.

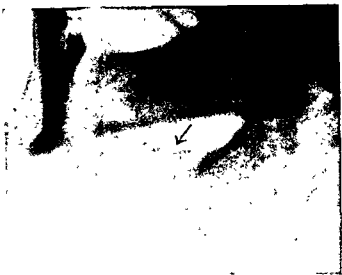
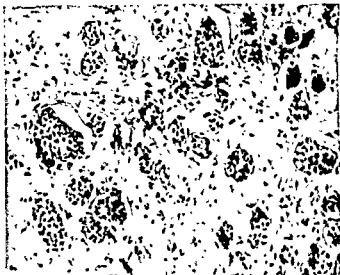


Fig. 8. a, left, Lateral roentgenogram of the mandible. The histopathologic diagnosis is metastatic carcinoma from the breast (Figs. 8 b and 1 d). b, Photomicrograph of specimen obtained from Case II G.



men obtained from Case II G. Note islands of malignant undifferentiated epithelial cells. Diagnosis: carcinoma of the mandible (metastatic from the breast) (Fig. 8 a).  $\times 125$ .

**Fibrosarcoma.** H.F.G., white male, aged 4 years, was first seen on January 4, 1945. About 8 weeks before the patient suddenly began to complain of intermittent toothache in the left mandible. Patient was examined by a dentist who found nothing wrong. The patient was examined by an otolaryngologist who likewise found nothing wrong and prescribed sulfanilamide. About 6 weeks previously a mass about the size of a grape was noticed in the left jaw. This continued to grow until at the present time it involved a considerable portion of the face. Extraoral examination revealed a large, hard, moderately tender mass which extended from below the lower border of the posterior part of the mandible up to the superior border of the ear. The anterior portion of the ear was pushed outward with the mass. Intraoral examination revealed a mass arising from the

mandible behind the last molar. The mass pushed the left tonsillar area over to the midline of the pharynx. On January 6, 1945, biopsy was made on the jaw tumor. The histopathologic diagnosis was fibrosarcoma (Fig. 6).

**Osteogenic sarcoma.** V.M.B., white female, aged 20 years, was seen on October 16, 1940. In July, 1940, the patient stated that her jaw on the left side began to swell. Patient went to a physician who took roentgenograms and said there was an impacted wisdom tooth. Physical examination revealed a diffuse swelling at the left angle of the jaw, firm and sensitive to pressure. The surrounding tissues were indurated. Patient was unable to open her mouth.

On October 17, 1940, an incision was made on the left side of the neck and the tissues elevated from the mandible. It was found that the entire half of the

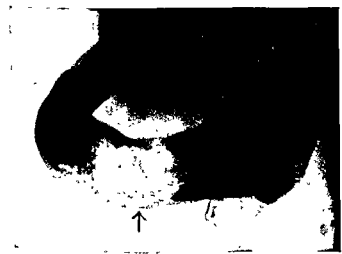
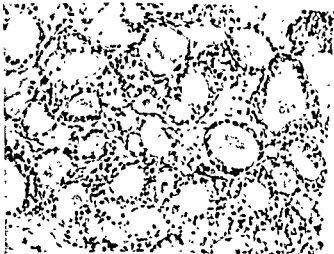


Fig. 9. a, left, Lateral roentgenogram of mandible. The histopathologic diagnosis is metastatic carcinoma from the thyroid (Fig. 9 b). b, Photomicrograph of specimen obtained from Case II H. The thyroid glandular tissue is



hyperplastic. The cells as a whole are well differentiated. Abnormal mitotic figures are not observed. Diagnosis: carcinoma of mandible (metastatic from thyroid) (Fig. 9 a).  $\times 125$ .

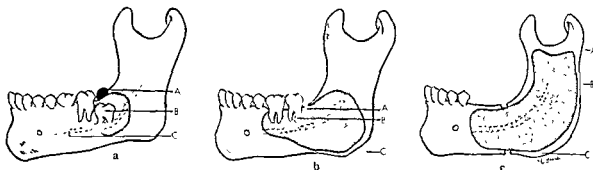


Fig. 10. Common errors made in diagnosis of jaw tumors. Presenting signs, symptoms, findings, and common misdiagnoses. a, Gum boil, granulation tissue, A, impacted molar, B; paresthesia and anesthesia of lip, pain in teeth

and mandible, C. b, Draining sinus, A; loose teeth, pyorrhea, B (Pyorrhea is not the only cause for loose teeth); swelling of face, C. c, Pain in ear, A; limitation of movement of jaw, B; fracture, C

mandible was involved with an invasive tumor. It was definitely malignant and too extensive to offer any hope of cure from a radical operation. The histopathologic diagnosis was osteogenic sarcoma (Fig. 7). Patient died on June 18, 1941.

*Metastatic carcinoma from the breast.* C.S.F., white female, aged 57 years, was first seen February 11, 1943. Patient complained of numbness and tingling of the lower lip since August, 1942. In addition at that time a lump was noticed in the right mandible. Patient went to a dentist who extracted the right lower molars, but there was no relief from the symptoms. She went to a physician who gave 8 deep x-ray therapy treatments. Patient had a left radical breast removal for carcinoma 1½ years previously and there had been no evidence of recurrence. Physical examination revealed a nontender, round, hard mass, 1.5 centimeters in diameter, in the right mandible at the molar region.

On February 12, 1943, in the region of the right molar, the buccal plate was removed exposing a hard tumor 3 by 2 by 2 centimeters which was removed and the bed cauterized with heat. The specimen was white, very firm and appeared to be fibrous tissue. Tissue was sent to surgical pathology for rapid frozen section. The histopathologic diagnosis was metastatic carcinoma from the breast (Fig. 8).

*Metastatic carcinoma from the thyroid.* E.L.W., white female, aged 55 years, was first seen on October 25, 1938. This patient complained of dull pain in the left mandible for 5 weeks. Her dentist took roentgenograms of the jaw and found destruction of bone. Patient stated that she had had a goiter for 25 years, but it had remained unchanged. Physical examination revealed that on the lingual surface of the left lower jaw in the premolar area there was a mass which extended down to the lower border of the jaw. It was palpated on the outside where it was quite painful. There was a stony hard diffuse enlargement of the right lobe of the thyroid gland.

On October 26, 1938, an opening was made into the jaw bone and a rather vascular type of tumor was removed. The microscopic report was metastatic carcinoma from the thyroid (Fig. 9). On November 2, 1938, the right lobe and the isthmus of the thyroid

gland were removed and the microscopic report was adenocarcinoma of the thyroid. Patient was again seen on June 7, 1942, complaining of pain in the right iliac crest and difficulty in walking. Two series of x-ray therapy each consisting of 2400 roentgen units were given to this area. Patient was again seen on March 31, 1943, and she stated that she had pain in the left mandible since October, 1942, and during the last few months a lump had appeared. She had had no complaints in regard to the jaw since the last operation of 1938. The mass was excised by means of cautery and found to be metastatic thyroid tissue. The tumor of the ilium was also excised and this too was found to be adenocarcinoma of the thyroid. The patient was last seen in 1945 and no evidence of carcinoma was found.

## DISCUSSION

*Roentgenograms of the mandible.* Entirely satisfactory roentgenograms of the mandible are usually difficult to obtain. The masseter and internal pterygoid muscles, the pharynx and other soft tissue structures interfere. In addition, superposition of the other side of the mandible, the maxilla, the vertebrae, and the thyroid bone confuse the picture. Comparison of preoperative roentgenograms of the mandible with roentgenograms of the resected tumor and mandible reveal striking differences (1). The latter, devoid of surrounding tissue, show remarkably sharp. This problem is partly answered clinically by use of the laminagram.

*Classification of "cystic" lesions of the mandible.* Any practical clinical classification of "cystic" lesions of the mandible should be all inclusive. Many errors are made in the clinical diagnosis of jaw tumors (Fig. 10). The histopathologic diagnosis is specific. The roentgenographic diagnosis, however, is non-

specific and includes many tumors which are radiolucent but not truly cystic. Consequently, in the differential diagnosis the following should be considered on a roentgenographic basis.

#### TUMORS OF THE MANDIBLE

- I. Tumors of dental origin.
  - A. Follicular cyst (single and multiple).
  - B. Dentigerous cyst.
  - C. Ameloblastoma (preameloblastoma).
  - D. Radicular cyst (or granuloma).
- II. Tumors of nondental origin.
  - A. Primary in mandible.
    1. Benign—
      - a. Giant cell,
      - b. Eosinophilic granuloma,
      - c. Fibroma,
      - d. Traumatic.
    2. Malignant—
      - a. Carcinoma (local spread),
      - b. Sarcoma (fibrosarcoma osteogenic sarcoma, Ewing's).
  - B. Secondary in mandible.
    1. Metastatic sarcoma and carcinoma.
    2. Altered body metabolism—
      - a. Hyperparathyroidism,
      - b. Lipoid disturbances (Gaucher's, Christian Schuller, etc.)

To the surgeon and dentist this classification is more valuable than one developed on a strict pathological basis of truly cystic lesions. It is important for the dentist to realize that "cystic" lesions of the mandible can be other than dental in origin and that they may not be primary in the mandible, but metastatic. Consequently it behooves the dentist and dental surgeon to be fully cognizant of the variety of "cystic" lesions of the mandible and to make early provision for adequate treatment. By the same token the oral surgeon must be prepared at the time of operation to do either a relatively simple enucleation of a true cyst or a difficult radical resection of a true mandible for a malignant tumor.

*Roentgenographic and clinical characteristics of the ameloblastoma.* The roentgenographic characteristics of the ameloblastoma are supposed to show multilocular radiolucent areas with a sharp smooth border. This is surrounded by a thin, narrow, radio-opaque zone. Smaller daughter areas connected with a larger radiolucent area have also been described as being characteristic. This description is probably better adapted to the cystic

phase of the tumor. There is no reason why any other cystic tumor should not look the same. Even solid tumors show a striking similarity. One should also remember that the ameloblastoma may be either unilocular, entirely solid, or solid and cystic and consequently the roentgenographic picture may be far from the "normal" (Fig. 1).

The ameloblastoma is generally considered to be a benign tumor. Because local recurrence is frequent, it has been sometimes said to be malignant. Complete removal of the tumor is made more difficult because of daughter cysts. Consequently what is believed by some to be a local recurrence is actually an incomplete removal. Rarely, the ameloblastoma will undergo true malignant degeneration and metastasize.

Because the ameloblastoma is generally considered to be a benign tumor, and because the roentgenographic pictures may be similar to malignant lesions primarily or secondarily in the jaw, it is of paramount importance to make an early correct diagnosis.

#### SUMMARY AND CONCLUSIONS

Multilocular radiolucent areas in the roentgenograms of the mandible have been demonstrated for ameloblastoma, multiple follicular cyst, giant cell tumor (local and general in origin), fibroma, fibrosarcoma, osteogenic sarcoma, and metastatic carcinoma (breast and thyroid).

The diagnosis of an ameloblastoma or of any other tumor of the mandible should not be made by means of the roentgenogram alone. There can be a wide variation in the roentgenographic findings of different ameloblastomas and they may simulate other tumors. And conversely other tumors of the mandible may simulate the ameloblastoma on the roentgenogram.

The primary value of the roentgenogram is to demonstrate the site and extent of the multilocular lesions of the mandible.

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# THE CHERNEY INCISION AS APPLIED TO THE SURGERY OF THE LOWER URETER AND BLADDER

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WHILE the suprapubic midline or low rectus incisions afford good exposure for most procedures directed toward the bladder and lower ureter, instances occasionally arise in which these approaches seem inadequate, particularly for surgery of the deep extraperitoneal pelvic zone, the extensive dissection necessary for total cystectomy, or for surgery of the vesical neck or subsymphyseal urethra. A transverse low abdominal incision has been recently described by Cherney which allows of extensive exposure of the lower portion of the peritoneal cavity for surgery of the lower bowel and female reproductive organs. This incision, which is readily applicable to urologic procedures, is described in the following paragraphs.

From the Division of Surgery, Subdivision of Urology, University of California Medical School, San Francisco.  
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The transverse skin incision is curved slightly, with its convexity directed downward, and extends from just medial and inferior to either anterior superior spine of the ilium (Fig. 1). The wound thereby passes through the upper pubic hair line, often following a normal skin fold, and is carried down to the aponeurosis of the external oblique muscles and the sheaths of the rectus. At either extremity of the incision the superficial epigastric vessels are encountered and one or both may be sacrificed for added exposure.

The sheaths of the rectus are then opened transversely in line with the skin incision and the internal and external oblique aponeuroses are next incised to the angles of the wound. In this portion of the incision, the internal oblique muscle becomes fleshy but, since its fibers run in line with the wound, the muscle may be split further by blunt dissection. Occasionally the transversus muscle is present

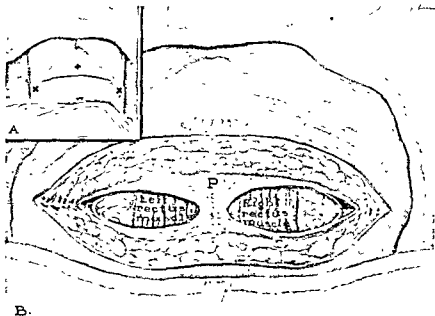


Fig. 1 The incision through the skin, sheaths of the recti, and lateral abdominal muscles. P, designates pyramidalis muscles under linea alba

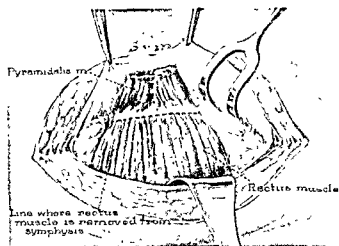


Fig. 2. The completed transverse incision. The pyramidalis muscles are separated from the underlying recti. The rectus muscles are transected through their points of origin on the pubis.

in the lower abdominal wall and then it also must be opened. This exposes the rectus muscles in the midline and the transversalis fascia and underlying peritoneum laterally.

Traction is next applied to the inferior flap of the sheath of the rectus and by gauze dissection it is freed from the underlying rectus muscles down to the symphysis pubis. A central fibrous septum extending from the under surface of the rectus sheaths to the recti must be cut and the pyramidalis muscles freed from the anterior surface of the rectus muscles (Fig. 2). The inferior ends of the recti then are separated from the underlying transversalis fascia and it will be noticed that

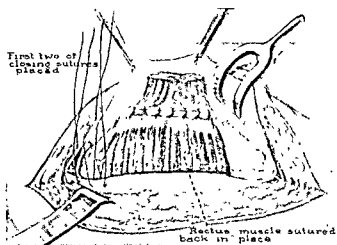


Fig. 3. Closure. The tendinous edges of the rectus muscles are resutured to the symphysis or under surface of the rectus sheath. The lateral abdominal muscles and the sheath are closed in one layer with interrupted sutures.

they become largely fibrous or even completely tendinous at their points of origin. The rectus muscles are cut off flush with the pubic bone, their tendinous ends being preserved for later resuture. The recti then retract well up to the upper border of the sheath of the rectus, exposing an elliptical space averaging 7 inches by 5 inches in its transverse and vertical axis respectively, an area twice that afforded by the midline incision and with its transverse axis much closer to the symphysis pubis than that of the latter. The transversalis fascia is then opened and the surgeon is prepared for wide exposure of the bladder or lower ureter.

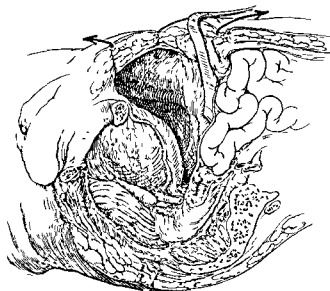
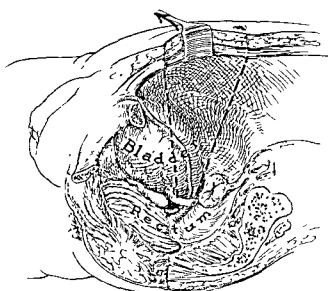


Fig. 4. a, left, Exposure gained with Cherney incision allowing excellent access to the deep extravescical space.



Compare with the limited exposure afforded by the vertical midline incision, b.

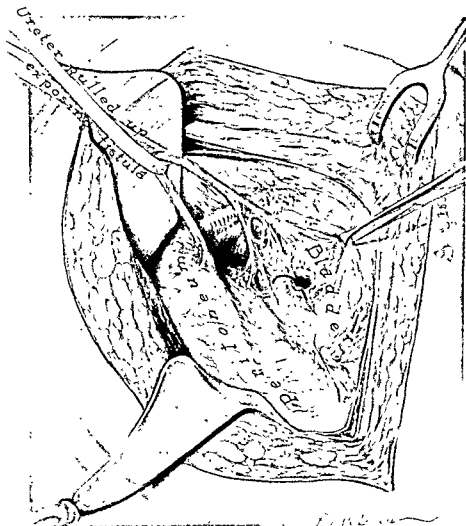


Fig. 5 Repair of vesicovaginal fistula adjacent to left ureter. Fistula excised and both vaginal and vesical openings easily inverted.

In the closing of the wound, the tendinous ends of the rectus muscles are first resutured to the under surface of the lower flap of the sheath of the rectus at or near the symphysis (Fig. 3). While considerable tension upon this suture line might be expected, it must be remembered that the rectus muscle is strongly attached on its anterior surface to the anterior sheath of the rectus by three or more transverse tendinous intersections so that when the transverse incision through the aponeuroses of the lateral abdominal muscles and rectus sheaths is sutured, the sheath itself takes the tension of the upper two-thirds of the muscle. Drains may be brought out through the incision or through a stab wound.

Certain advantages which this incision offers suggest its employment for selected surgical procedures: the transverse wound is longer than the vertical incisions so that exposure is increased. Vertical wounds give limited exposure because of the convergence of the sheaths of the rectus muscles at either angle of the wound even with strong lateral retraction. The Cherney incision gives excellent exposure at the plane of the symphysis overlying the deep pelvic zone (Fig. 4). The transverse wound is a strong wound. No muscle is denervated, the lateral abdominal muscles and the recti are divided at different levels, less retraction is needed, and lighter anesthesia therefore can be used. The direc-

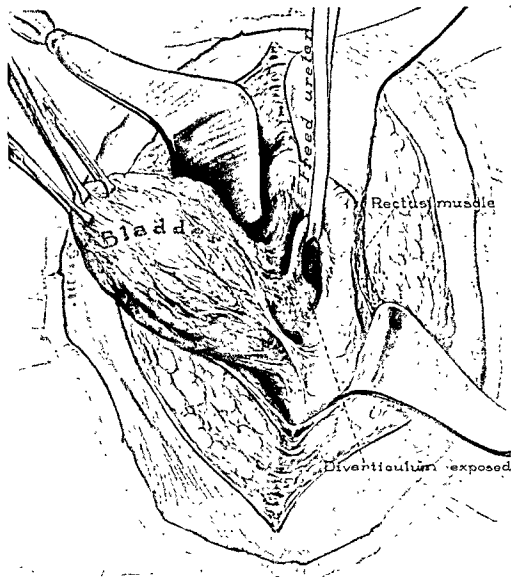


Fig. 6. Excision of vesical diverticulum posterior to right ureter. The use of the Cherney incision greatly facilitated its removal.

tion of pull of the oblique muscles with strain is parallel to the direction of the incision in their aponeuroses and all sutures are taken through fascia which makes for good healing, thereby decreasing the incidence of hernia.

#### CASE REPORTS

The following cases are presented to demonstrate the exposure obtained through this approach:

A woman, aged 20 years, developed a vesico-vaginal fistula following instrumental delivery of a stillborn hydrocephalic baby. Examination 8 months later showed the fistulous opening to be just lateral to the badly lacerated cervix and cystoscopy demonstrated the opening in the bladder to be 1 centimeter medial to the left ureteral orifice. Be-

cause of the proximity of the fistula to the left ureter, an approach affording good visualization of the area was deemed advisable, so a Cherney incision was used. After its identification in the region of the pelvic brim, the ureter was followed down to the bladder (Fig. 5), the bladder was opened, the fistulous tract excised, and the openings in both the vagina and bladder were closed by interrupted inverting sutures. A cystostomy tube was left in place for 10 days, and 2 weeks after surgery was performed the patient was voiding without vaginal urinary leakage.

A man, aged 60 years, had previously undergone transurethral prostatic resection but troublesome symptoms from persistent pyuria continued because of vesical diverticula in the region of the right ureteral orifice. Diverticulectomy was decided upon and the transverse incision was used because of the excellent exposure of the trigonal area which it affords (Fig. 6).



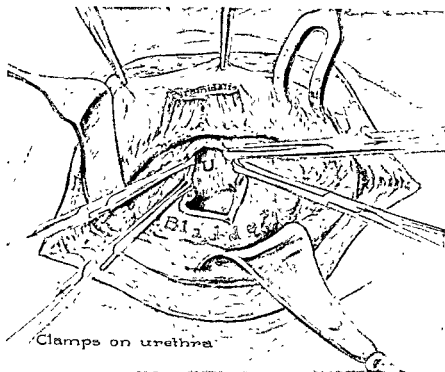


Fig 7. Resection of anterior half of urethra, U, bladder neck, and adjacent bladder wall for congenital defect of sphincter. In the closing of this defect, the distal suture in the urethra was easily placed even though it was situated below the inferior border of the symphysis pubis.

A girl, aged 6 years, complained of enuresis since birth as well as incontinence during the day. Renal function and urinalysis were normal. Cystoscopy demonstrated a markedly relaxed urethrovaginal sphincter and a patulous urethra. The anal tone was intact. Neurological examination revealed no sensory or motor changes and intravenous urograms were normal. Roentgenograms of the bones of the lower spine and pelvis showed them to be normal except for separation of the symphyseal rami by a distance of 1 inch. This suggested the probability of an anterior defect of the vesical sphincter such as one might observe in a minor degree of exstrophy, so it was thought advisable to explore the neck of the bladder and the urethra. Exploration was done through a Cherney incision with admirable exposure resulting (Fig. 7). The anterior half of the urethra and vesical neck were resected and the remainder closed, the deepest suture being placed inferior to the lower border of the symphysis pubis under direct vision.

The results obtained for these patients might not have been as satisfactory if an

approach offering less exposure had been chosen. One of the fundamental rules of good surgical technique is to gain adequate exposure. The Cherney incision fills this requirement in a superior manner.

#### SUMMARY

1. The Cherney incision offers excellent exposure of the extravescical trigonal area (juxtavesical stone, diverticulum of the bladder, vesicovaginal fistula, etc.), vesical neck and subsymphyseal urethra. It is peculiarly suited for total cystectomy.
2. The technique of the approach is described.
3. Cases are presented which illustrate its advantages.

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# THE EXPOSURE OF HIGH LESIONS OF THE SCIATIC NERVE

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THE inadequacy, difficulty, and danger of the classical nineteenth century approach to the structures under cover of the gluteus maximus through an incision in the line of its fibers were exposed by Fiolle and Delmas, whose 'trapdoor' elevation of the gluteus maximus can now be regarded as the standard procedure. A similar technique was described by Stookey, whose question-mark incision later authors have adopted. Henry has recently elaborated the operation, and has described its steps with a wealth of anatomical detail and argument which could hardly be more complete. In this paper a full description of the operation will not be attempted, but during the recent war certain problems in the management of high lesions of the sciatic nerve have emerged, and the measures devised to solve these may be added to the operative procedure.

The main difficulties encountered in the repair of a lesion of the sciatic nerve at its emergence from the pelvis are four in number: (1) hemorrhage from the branches or the main trunk of the inferior gluteal vein; (2) retraction of the neuroma into the pelvis; (3) inability of the nerve to rotate for the insertion of the anterior layer of sutures; and (4) liability of the posterior cutaneous nerve of the thigh to injury, not when the fascia of the thigh is incised initially, but when it is closed at the end of the operation. How these difficulties occur and how they can be overcome, are best illustrated by a brief description of the operation.

*The incision* (Fig. 1). With the patient prone and the knee pillowed to hyperextend the hip, the incision is begun at a point on the crest of the ilium a handsbreadth in front of its posterior superior spine, and the knife is drawn down to the tip of the greater trochanter, over the lateral aspect (not the posterior edge) of the trochanter, and then in a curve inward to the junction of the gluteal fold with the posterior axial line of the thigh. From this point the incision passes vertically downward toward or into the popliteal fossa as far as may be required for the adequate mobilization of the distal segment of the sciatic nerve.

*Division of fascia.* In the lower (vertical) part of the wound the fascia of the thigh is incised parallel to and just lateral to the posterior cutaneous nerve of the thigh, whose white outline is clearly visible through the fascial sheet. The lower edge of the gluteus maximus is defined between the point of emergence of the posterior cutaneous nerve of the thigh and the femoral insertion of the muscle.

*Mobilization of the gluteus maximus.* In the outer part of the wound, a vertical incision is made down to the lateral surface of the greater trochanter through the iliotibial tract. This provides the most convenient access to the space deep to the gluteus maximus; elsewhere a subgluteal plane of cleavage is difficult to identify. A finger in-

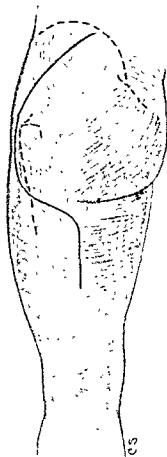


Fig. 1. Incision.

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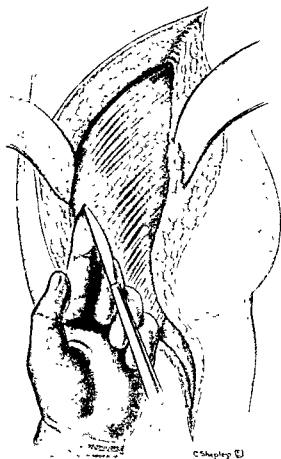


Fig. 2. Division of insertion of the gluteus maximus.

serted through the fascial incision can be readily passed upward under the junction of the upper fibers of the gluteus maximus with the iliotibial tract, to serve as a director for the knife (Fig. 2). This incision continues upward to the superolateral border of the gluteus maximus, and then along that border, dividing the iliotibial tract and freeing the superolateral border of the muscle completely. Now that the superficial portion of the gluteus maximus is mobilized, all that remains is to pass a finger upwards from the outer end of the lower border of the muscle, close to the femur, and to divide the muscle fibers of the deeper part close to their insertion into the femur.

*Retraction of the gluteus maximus: division of the piriformis (Fig. 3).* A broad-bladed retractor elevates the gluteus maximus upward and medially to expose the piriformis and the structures emerging from the cover of its lower border, but the initial elevation of the muscular trapdoor must be gentle, for as it is retracted, the branches of the inferior gluteal vessels passing to its deep

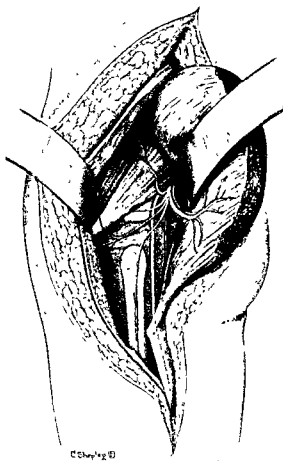


Fig. 3. Elevation of the gluteus maximus: division of tendon of piriformis. Note the spread eagle stretching of the branches of the inferior gluteal vessels, and the risk of tearing at the multiple bifurcations between them.

surface are pulled dangerously taut. This danger is implicit in the observation of Fiolle and Delmas (p. 45 of the English translation) that "the superficial branches of the gluteal vessels which supply the muscular mass become tense, like cords, between the sciatic notch and the under surface of the upraised muscle." The main trunks of the inferior gluteal vessels are relatively fixed by the lower border of the piriformis, and sometimes absolutely fixed by scar tissue at their emergence from the pelvis, and tributaries of the gluteal vein may be torn. Bleeding is particularly obstinate if one of the muscular tributaries is torn from the parent trunk, or if two converging tributaries are pulled apart to provide a longitudinal rent splitting the parent trunk; such bleeding may be almost uncontrollable if the torn proximal end of the vein is fixed in the sciatic notch by dense scar tissue. However, if the tendon of the piriformis is now cut across close to its insertion (Fig. 3),

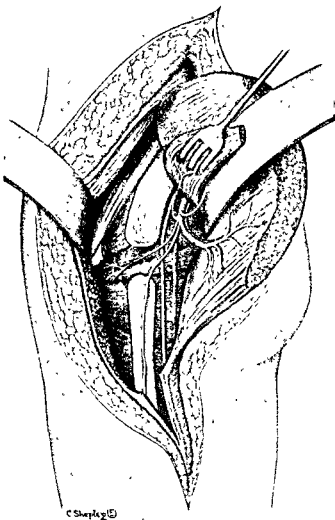


Fig. 4. Piriformis retracted with the gluteus maximus. Tension on the inferior gluteal trunks is lessened, a greater length of these trunks is exposed. The companion vessels of the sciatic nerve, and a laterally passing branch of the inferior gluteal trunk, have not yet been divided; their division will still further lessen the tension on the muscular branches. Note the additional length of the proximal cut end of sciatic nerve exposed by division of the piriformis.

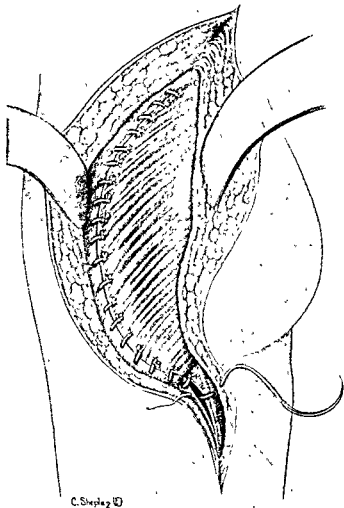


Fig. 5. Suture of the gluteus maximus. Note the needle picking up the fascia of thigh clear of and well medial to the line of the posterior cutaneous nerve.

vided before the trapdoor is fully raised, there is less risk of tearing at their V-junctions with the branches to the gluteus maximus.

cleared at its margins by blunt dissection, and elevated by a rake retractor in the same direction as the gluteus maximus, some additional mobility is afforded to the main trunks of the inferior gluteal vessels (Fig. 4), and the anastomosing branches which course upward over the surface of the piriformis to meet the descending branches of the superior gluteal vessels are retracted in the same direction as the superior muscular branches. Even if bleeding occurs now, a substantially greater length of the main gluteal vessels is available for ligature. An additional safeguard against hemorrhage is the formal ligation and division of the companion vessels of the sciatic nerve, and any laterally directed branches of the inferior gluteal vessels. The former and one of the latter are shown undivided in Figure 4; if they are di-

vided before the trapdoor is fully raised, there is less risk of tearing at their V-junctions with the branches to the gluteus maximus. Figure 4 shows a further advantage of the division and elevation of the piriformis—wider access to the proximal cut end of the divided sciatic nerve. In 3 patients with sciatic nerve lesions treated in 1945, the nerve had been wounded at such a high level, and its proximal end had retracted so far into the sciatic notch, that only the distal extremity of the neuroma could be drawn from below the piriformis. Division and elevation of the piriformis in each of these cases afforded access to just these few extra millimeters of the sciatic trunk which were necessary for trimming and suture. In 1 case suture was performed at the level where the nerve was beginning to broaden in its parent plexus.

*Technique of anastomosis.* If the normal technique of nerve suture is followed at this level, and the superficial row of sutures is inserted first, it

In contrast to the "passive types" are the "active types" of prostheses, the parts of which are activated in varying degree by muscle movement. Their many types conform to two main groups:

a. Some utilize the extraneous muscle movement in relation to remaining joints to effect movement in the prosthesis. Most of these rely on a development and practice with the same or opposite shoulder movement. The standard cleft hook is well known of this type, and Carnes' arm is probably the best of the many designs on this principle. Many others have become scrap metal. All employ strings, pulleys, cords, or wires which require unnatural action or motion for a function which does not fully duplicate hand movement. In general, their cumbersome action tallies badly with their nuisance value to all and what to most implies a hopeless range of personal endeavor, training, and concentration to make them effective.

b. The other main group of active prostheses involves the principle and subject of cineplasty.

*Cineplasty.* Cineplasty implies utilization of the muscles actually within an amputation stump to impart some of their normal function to an appropriate prosthesis. It requires some type of surgical operation on the stump by which the unused and wasting source of muscle potential is utilized. Function is produced in a way which cannot be achieved by other methods, for direct control of the mechanism can be effected by the same muscle groups which would normally be producing that same action in a hand. Normal psychomotor patterns are involved. There is no latent period of inertia in activating or training extraneous muscle groups, and the patient has encouragement in the first use of a cineplastic prosthesis. We must remember, however, that cineplasty implies a mechanical prosthesis, still with a nuisance value, a necessity for maintenance, and an absence of tactile facility.

The principle of cineplasty was elaborated about 1896 as a theory, by the Italian physician, Vanghetti. He was thinking for the mutes among Italians fighting in Abyssinia at that time. Vanghetti himself did only experimental work, mainly on birds. It was long

before he could convince one of his compatriots—one Ceci of Pisa—to do the first human cineplastic operation. Such procedures, however, had no effective trial until the mutes of the 1914-1918 war had accumulated. Then Sauerbruch in Germany and the Italian school at Bologna (Ceci, Putti, Galliazzini) did large numbers of these operations in special clinics where there was apparently a very close liaison between surgeon and prosthetist. The few references in British literature are either by extraneous observers at these clinics or by the Continental men themselves. There were sporadic and isolated trials by individual surgeons, but the method received no general acceptance or favor. American writers have been more enthusiastic—Kessler, who studied in the Sauerbruch clinic, is apparently a practiced exponent and advocate of this principle.

A necessity for the highest order of teamwork explains the apparent discrepancy; why cineplasty has achieved a success and favor only in special clinics where large numbers are done, and not in sporadic trials among isolated cases. The basic organization in the special plastic surgery clinics throughout British and Imperial countries, thanks to the teaching and inspiration of Sir Harold Gillies, has offered unusual scope for such teamwork. In this Unit, attached to a large city base hospital, and where we have extended our prosthetic facilities beyond the usual, we have thought fit to evaluate for ourselves—by a limited first hand trial—something of the place of cineplasty for the upper limb amputee. In so doing, both concerning the plastic operation involved and the prosthesis used, we have endeavored to make improvements in what we could discern of their more obvious shortcomings. This work has so far been confined to forearm cineplasty and our present conclusions are epitomized in two chapters: (1) The plastic operation involved, (2) The prosthesis used.

#### THE PLASTIC OPERATION

There are many ways in which the muscle function of an amputation stump can and has been tapped. Sauerbruch's method has apparently best survived the sieve of time and trial. By it, a skin lined canal is made through

individual muscles or groups of muscles in a stump. Through these canals are inserted pegs, the movements of which are transmitted by appropriate mechanism of a prosthesis to produce movement of an artificial hand.

The permutations of procedure which could be applied to the making of a skin lined tube through muscle are many, but in view of the work of such a skin tube, we consider the following general principles should be satisfied in its making:

a. The tube must be a soundly healed and stable structure.

b. Any local operative procedures involved should create a minimum of scar formation which is likely to embarrass mobility of the tube.

c. The stump to which the prosthesis has to be fitted should be left devoid of anesthetic areas, areas of vulnerable scar, and wherever possible devoid of free skin grafts. Free skin grafts on an amputation stump are not always a satisfactory proposition. They are potentially unstable with petty trauma and they become adherent to deep structures in some degree. If a free graft has to be used, it should not overlie the area of muscle transfixion or the end of the stump.

With these factors in view, one of us (B.K.R.) has evolved an effective cineplastic operation which can be done simultaneously with an amputation or reamputation. The muscle tube is made of a skin and fat flap, its line of suture is off the line of pressure of the transfixion rod. It is a one stage operation in which free skin grafts are not used, and which is devoid of undue risks with flap vitality.

This operation can be done without modification only where there is sufficient length of limb for the use of the skin flaps from the region to be amputated. We would emphasize on this basis alone, the value always of the most conservative primary upper limb amputations which would render such a subsequent procedure possible and satisfactory. If remaining length of limb does not permit of the operation, a compromise in the method is required, and use of a supplementary free skin graft may be necessary. Chief of the modifications we have used will be indicated after the one stage operation is described.

*Cineplastic reamputation.* The stages of cineplastic reamputation are best followed in reference to Figure 1.

1. *Surface markings* (Fig. 1, a)  $XX'$  is the line of election for constructing a skin canal through the superficial plane of forearm muscles. It represents the junction of the middle and distal thirds of the middle third of the full length of forearm. It is drawn at right angles to a line from the medial epicondyle to the midvolar wrist in the case of the flexor group, or a line from the lateral epicondyle to mid-dorsal wrist in the case of the extensor group of muscles.

This line  $XX'$  respects two primary anatomical considerations as pointed out by all exponents of Sauerbruch's principle: (a) The strongest available potential of muscle power and excursion is at the region where contracting muscle belly gives place to passive tendon. In the forearm, this potential is approximately in the distal third of its middle third. (b) The superficial forearm muscle groups have a slightly oblique set on account of their essential origins from the humeral epicondyle regions. This fact must be remembered so that the tubes are made through the muscles, exactly at right angles to their direction of pull.

These facts are best verified and marked before operation with a co-operative patient.

The line  $XX'$  is only an approximate estimate and because of unpredictable variations in individual amputation stumps with varying degrees of muscle retraction, we consider it best to approach this line with a demilunar skin incision  $YY'$  which will allow some variation of  $XX'$  according to exact findings. It will also ensure that there is no potential scar to become adherent to the muscle over its line of canalization.

*Identifying and canalizing the muscles* (Fig. 1, b, c, d). After the skin flap  $YY'$  is raised the deep fascia is incised and the superficial plane of muscles is identified. The flexor muscles selected for canalization are the flexor digitorum sublimis (superficial portion) and the flexor carpi radialis, both of which can be transfixion in the same plane. The main mass of the flexor carpi ulnaris is usually too far posteriorly to be included.

It is important to ensure that the tube actually passes through muscle substance—it is easy to slip in between muscle planes. In the first instance, transfixion is conveniently effected under careful vision, a pair of eye scissors being used (Fig. 1, c). This line of muscle transfixion is then dilated by successive passage of a special set of graded and interlocking solid metal dilators (Fig. 1, d). On the two larger of these can be fitted and passed through the muscles bored hollow metal tubes which measure  $\frac{1}{2}$  inch by  $\frac{5}{8}$  inch. The smaller tube is used for small limbs or if further dilation proves difficult. The appropriate hollow tube is left *in situ* as a dilator while the skin tube is being made.

3. *Designing and making the skin tubes.* On the ulnar side of the forearm, a rectangular skin flap *ABCD* is designed (Fig. 1, e) with its base *AB* obliquely across the transfixion line *XX'*, its sides parallel, and its dimensions depending on the length and bore of the muscle canal. In an average case, this requires a flap approximately  $2\frac{3}{4}$  inch by  $1\frac{1}{2}$  inch.

After the flap is carefully raised on the base *AB* (Fig. 1, f), it is turned in to make a skin lined tube. This step is facilitated by first inserting at each end an inverted end on mattress stitch, tied with knots on the skin surface. These are used as stay stitches. One stitch coapts *C* and *D*, but the other must be sufficiently distant from *A* and *B* to allow the skin edges to come together without undue tension (Fig. 1, g). After an appropriate size rubber tube is inserted, the skin lined tube is completed by a continuous subcutaneous running stitch which is first tied to the near stay stitch and finally to the far stay stitch (Fig. 1, h). An assistant holds appropriate tension in the continuous stitch during its insertion. Fine silk on an atraumatic needle is used.

4. *Passing the skin tube through the muscle canal.* With the aid of a pair of sinus forceps passed down the metal tube from the end opposite the base of the skin tube, the stay stitch and rubber tube at its free end are guided into the near end of the metal tube which should not be projecting far beyond the muscle opening on that side (Fig. 1, j, h). The skin tube is then drawn carefully into the metal tube. On removal of the metal tube

from the far side, the skin tube is left *in situ* through the muscles (Fig. 1, i). This method radically simplifies what is otherwise a very tedious procedure.

5. *Completing the skin tube.* The initial exploratory flap is then resutured in place and the open ends of the skin tube are carefully sutured all around their margins to outside skin.

On the dorsum of the forearm, the same procedure is repeated in complementary design. The extensor digitorum communis and extensor carpi ulnaris muscles are used, but the canal is usually slightly shorter than that through the flexor muscles. In this case, the flap used for making the skin tube is designed on the radial side of the forearm.

When both tubes are completed, there remain two secondary defects which are the donor sites of the skin tubes—one on the ulnar side of the volar aspect, the other on the radial side of the dorsal aspect of the forearm.

### *The Reamputation*

Two amputation flaps are raised on lateral bases, but contain skin from the volar and dorsal surfaces of the forearm respectively (Fig. 1, j, k, l).

The anterior flap *EFGH* is raised on an oblique base *EF* on the radial side of the limb. It consists essentially of volar skin. The posterior flap *JKLM* is conversely raised on an oblique base *JK* on the ulnar side of the limb and it consists essentially of dorsal skin.

It will be noted that each of these flaps consists mainly of the skin distal to the raw areas. When rotated in opposite directions they close these areas as well as the site of reamputation.

These flaps must be designed very accurately and carefully. The skin areas proximal to their base lines *EF* on the radial side and *JK* on the ulnar side as represented by the shaded areas on Figure 1, j, k, l, might well be described as "the critical areas." There must be no undermining of skin edges in this region, on which depends the existence of the flaps. This step constitutes one of the main points of the operation. The free distal end of the one flap is on the margin of the critical area of the other flap.

After the flaps are raised, the muscles are divided at a level as far proximal as the bases of the flaps will allow, care being used not to jeopardize their blood supply further (Fig. 1, l). After proximal traction on the severed muscles, the bones are divided at a level slightly proximal again to the severed muscles.

After routine hemostasis is effected, the deep muscles are sutured over the dorsal ends, but the superficial groups which have been canalized are left free to retract.

### *Final Suturing*

Rotation of the volar and dorsal flaps in opposite directions (Fig. 1, m) allows each to close the donor site of the skin tube on its respective aspect without undue tension, and the distal curved margins of each flap are sutured one to the other over the amputation site. This method makes a curved suture line in a coronal plane around the end of the stump.

Silk sutures are used throughout with every precaution and finesse for accurate edge-to-edge apposition.

The final arrangement and suturing is shown in Figure 1, n, o, p.

Rubber tubes are left through the skin tubes, but they must not be too large and tight.

A routine dressing and light crepe bandage pressure is arranged over the whole stump. This is left undisturbed for a week.

### *Postoperative Management*

At the first dressing, 1 week after operation, half the superficial stitches are removed. The rubber tubes are removed from the skin tubes. The continuous stitch through the length of the skin tube is carefully identified from its fixation to the two separate end stitches, and all are carefully removed. If the running stitch feels tight, it is left a few days longer.

Through the skin tubes are then passed acrylic rods made to appropriate diameter. It is important to see that for a time these are always passed from the base side of the skin tube flaps and removed from the opposite side.

Remaining sutures are removed a few days later, after which the rods are removed daily for routine toilet of the skin tubes.

Healing should be complete in from 2 to 3 weeks, when voluntary active contractions of the appropriate muscles are commenced. Function is slowly increased, and after another 2 weeks, exercising against increasing resistance is arranged as in Figure 2. Exercise is continued until adequate force and excursion are developed when the appropriate prosthesis is fitted. Average excursion is  $\frac{1}{2}$  inch to  $\frac{3}{4}$  inch for the flexor rod and  $\frac{3}{8}$  inch to  $\frac{1}{2}$  inch for the extensor rod. The final result and appearance is shown in Figure 3.

### *Variations from the Described Operation*

It is obvious that the one stage cineplastic reamputation implies an adequate length of amputation stump, i.e. more than  $\frac{2}{3}$  of the forearm must be present, otherwise there is insufficient local skin flap available for the operation described without undue tension.

For stumps already too short for the cineplastic reamputation as described the following may be necessary:

1. In most of these cases it is usually necessary to use a free skin graft on the donor site of the skin tubes. As a free graft on an amputation stump is always a vulnerable area, if one has to be used it should not be placed over the end of the stump, nor do we consider it should be over the muscle tubes where its contraction and associated scar would embarrass the desired function of the tube. This point we consider the main disadvantage of the simple and commonly used method of making a skin tube through muscle as practiced by Sauerbruch and advocated by Nissen and Bergmann in their excellent monograph on this subject. If a free graft is required, the skin tube can be made exactly as described in the elective operation, and the secondary defects grafted as they stand with thick split skin (Fig. 4). In one case, contraction of the graft did produce a bad distortion of an extensor tube which had to be abandoned.

2. *The single tube operation.* In some cases, rearrangements of the amputation flaps will permit of making one skin tube without resort to free grafts. In 2 cases, a well functioning flexor tube has been made and the prosthesis modified accordingly so that a light spring takes over the function of the extensor mus-



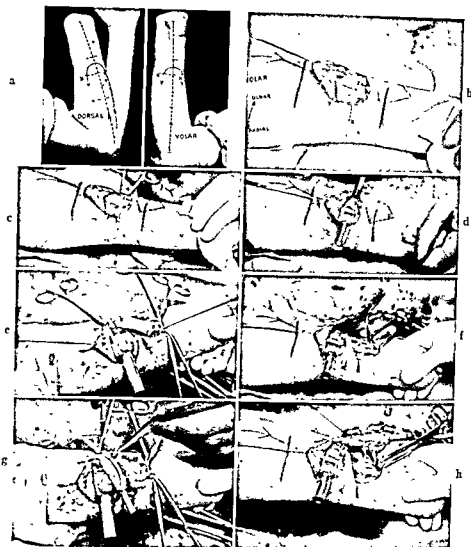


Fig. 1. a to h, Stages and technique of cineplastic reamputation of forearm.

cles. The possible advantages of this more simple procedure are still open to consideration and will be considered later.

3. *Use of abdominal flaps.* Some stumps still shorter, though still adequate for cineplasty, may not permit of free local use of skin for making skin tubes. Local scarring might also produce this same consideration. It may then be necessary to design and evolve skin tubes from other body regions in a staged operation (Fig. 5).

Disadvantages associated with any of these variations reiterate the advantages of the one stage cineplastic reamputation as described and again call for every effort to conserve

always the maximum length of upper limb in primary surgery of injury.

#### THE PROSTHESIS

In an endeavor to reduce some of the usual deficiencies pertinent to normal upper limb prostheses and other cineplastic mechanisms, we have concentrated in three main directions:

a. *The outward esthetic appearance.* It is considered that with the modern materials available, some better replica of the normal hand should be possible which would ensure its continued use on this score alone.

b. *An efficient, intrinsic mechanical leverage system*—to transmit the muscle power to move-



Fig. 1, i to p.

ment of artificial fingers in the most effective way.

*c. Reduction of the total weight of the prosthesis*—to well below ordinary standards.

To such ends, in 2 years of experimental construction and trial, in relation to a small series of selected cases, taking advantage of modern materials available and with many variations in their use and construction, we have elaborated a satisfactory working principle and prototype.

This forearm cineplastic prosthesis, which we call the Heidelberg pattern, is depicted in Figure 6. Its general mechanical arrangement and assembly is shown in Figure 7. Full de-

tails of all its essential parts are beyond the scope of this report, but its essential features will be expanded "seriatim" relative to (a) the hand superstructure; (b) the intrinsic mechanism; (c) the accessory fittings.

#### *The Hand Superstructure*

The hand superstructure is made in acrylic (methyl methacrylate) resin, as a hollow casing which minimizes weight and provides space for the mechanism. Acrylic was selected for its lightness and a transparency which renders it suitable for realistic color effects beyond that of ordinary materials previously used. In order to produce the exact replica of

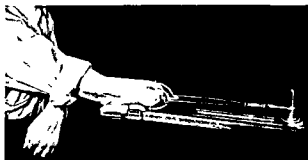


Fig. 2. Mechanism used for exercising muscles following cineplastic amputation. Note arrangement of transfixion rods, stirrups, and tension spring.

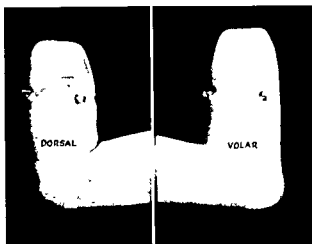


Fig. 3. Final appearance of stump, 3 months after a one stage cineplastic operation

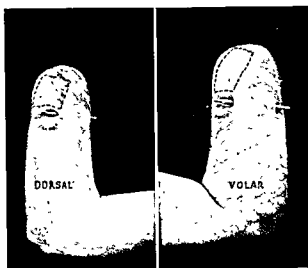


Fig. 4. The dotted outline indicates placing of free skin grafts on secondary defects of skin tube flaps. A method used when length of stump does not permit of the described operation.



Fig. 5. Skin tubes made from direct abdominal flaps in a two stage operation. This method may be necessary with very short or scarred stumps. b, Tube flaps are still attached to abdomen.

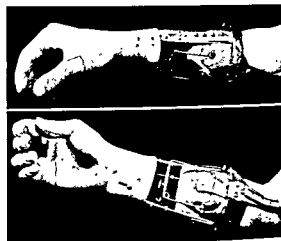


Fig. 6. The "Heidelberg" prosthesis as it appears fitted to an amputation stump.

a normal hand, full impressions were first made from selected normal hands with a hydrocolloid impression material.<sup>1</sup> From these impressions, models of the hand were made in artificial stone.

The acrylic hand casing is made in 10 separate segments. Each of these segments is made in a die of plaster prepared from appropriate pieces of the stone model which is fragmented as shown in Figure 8. Use of a special tubular saw, illustrated in the same figure, permits of cylinders being taken out of the bases of both the thumb piece and the two adjoined opposing fingers. These regions constitute the only two ultimate moving joints of the prosthesis. The ring and little fingers are dummy.

<sup>1</sup>*Impression technique.* Two ounces agar agar, 3 pints of water, small piece of soap (the size of a marble), a handful of cellulose wool. Boil the water and pour over the Agar (cut agar into small pieces). Boil mixture in double saucepan until dissolved. Add soap and cellulose wool, stirring well. Remove mixture from flame, allow to cool to blood heat, and apply with a soft brush. When well dry, cover with plaster of Paris. When plaster is dry, remove cast and pour up.



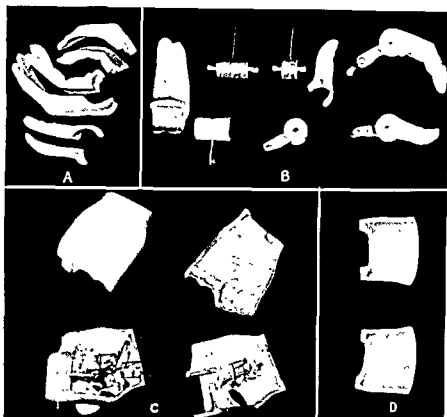


Fig 9. To show the separate acrylic segments of the hand casing and something of their assembly: A, Segments of the finger pieces (6). B, Arrangement of assembled fingers and fitting of drums in the cut-out bases of thumb and the two fixed opposing fingers. The dural bases of the acrylic coated drums are shown. C, Front and back portions of the hand proper—2 sets, showing the fitting of the finger drum and early stages of infitting the mechanism. D, Separate halves of the wrist casing

color can be added to the external surface by painting with an acetone solution of appropriate pigment.

A disadvantage of acrylic is its smooth, hard, slippery surface, unsuited to the handling of small objects. To offset this, the contiguous surfaces of thumb and opposing fingers are cut out with a drill and the defect made up by in-fitting cushions of polyvinyl chloride (artificial rubber). These pads are made concave on their inside, which increases the cushion effect. They are processed in place with acrylic gum.

The separate pieces of the hand casing are fused together by a thin mix of acrylic or a special gum. Volar and dorsal halves are left separate until the mechanism is in-built. The in-building is facilitated by provision in the internal structure of the shell of appropriate

platforms and projections for attaching the mechanism.

#### *The Intrinsic Mechanism*

Details of the intrinsic mechanism are represented in the "exploded" diagram, Figure 10. Mild steel case hardened, duralum in and brass are all used in the mechanism, with a view always to the most effective combination of lasting strength and lightness.

The essential principle consists of a transmission of the muscle pull by a system of stirrups and transmission rods to a double toggle system of levers. One of these toggles effects movement of the thumb by its attachment to a drum in the thumb joint. The other toggle similarly effects movement of the fused index and middle fingers. Intercepting the

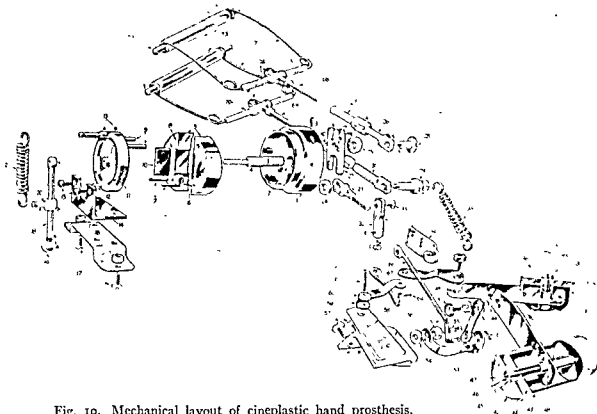


Fig. 10. Mechanical layout of cineplastic hand prosthesis, Heidelberg pattern. (Details concerning mechanism to be obtained by writing authors.)

transmission rods is a brake drum which serves a three-fold purpose: (1) it projects extensor and flexor muscle function, acting in converse ways to the common toggle system; (2) it has an equalizing effect on the difference in power between flexor and extensor muscles; (3) it acts as a locking device, so that a fixed grip can be maintained in any position without continued muscle effort.

The chief features effecting this mechanical principle are:

1. *Metal stirrups.* Each stirrup forms a spring clip with the metal core of acrylic rods which are made to fit the muscle tunnels in the stump.

2. *Connecting rods.* These are attached to the center of each stirrup and include hinges to give a universal movement. The flexor rod is attached to the lower portion of the brake drum, but its effective pull is continued by the toggle system. The extensor rod is attached to the opposite diameter of the brake drum surface.

It will be noted that by this arrangement, both flexor and extensor rods can produce

their contrary effects on the common toggle system.

3. *The brake drum and locking device.* This feature essentially consists of a drum turned to shape from dural rod (Figs. 11 and 7). Into the drum are fitted friction or brake shoes which are brought into the locking position by a cam shaft operated by a lever, which passes

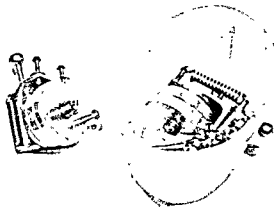


Fig. 11. The brake drum and locking device, and its location in the wrist casing.



Fig. 12. The general appearance and usefulness of the Heidelberg pattern forearm cineplastic prosthesis.

through the wrist casing. The shoes are brought firmly against the inside of the drum to act like the brakes of a car.

The operating lever is fitted with a tension spring arranged in an eccentric manner to hold the lever in either the locked or unlocked position.

On the smooth surface of the drum the connecting rod from the flexor stirrup to the toggle system is intercepted by and runs freely on a screw which is placed as near as possible to the edge of the drum. With muscle contraction to close the finger, the drum revolves with the pull of the flexor rod. Diametrically opposite on the drum, the extensor operating rod is attached by a screw to a slotted plate on the drum. This plate can be moved in or out from a central position, so altering the radius and increasing or decreasing the length of effective pull of the extensor rod. By this

means, variation in the relative strength of the extensor muscle is catered for. The relatively weaker pull of the extensor muscles is also assisted by an antagonizing spring on the flexor connecting rod.

4. *The finger drums.* The finger drums form the mobile joints of thumb and apposing fingers. Each consists of a hollow duralumin drum with fitted ends and coated with acrylic (Fig. 9). Through the center of each drum, a core of duralumin tube serves two purposes. To it is fixed the metal lever on which the toggles are attached, and it also accommodates bearings at either end in which fit stainless steel pins forming the axle of the drum.

#### *The Accessory Fittings*

The wrist portion of the assembled hand is attached by duralumin bars (1) to a leather

and/or metal cup<sup>1</sup> which must be made for each case to fit accurately to the end of the amputation stump. It acts as a counter pressure point for the effective pull of the muscles through the intrinsic mechanism. (2) The bars further extend to a second attachment on one ring of a ball race situated at a level below the elbow region.

By the ball race, some pronation and supination movements are obtained. The other ring of the ball race is attached by elbow hinges to a well fitting but not tight molded armcuff. The cuff is trimmed and arranged so as not to embarrass the biceps muscle. The usual accessory body straps are attached as required.

#### THE MODIFIED HEIDELBERG PROSTHESIS FOR A SINGLE TUBE CINEPLASTY

In these cases, only the flexor muscles are used. All parts of the prosthesis pertinent to the extensor muscles are dispensed with. The opening of the grip is effected by a spring antagonizing the flexor rod in a position as indicated in Fig. 7.

*Considered advantages of the Heidelberg prosthesis are:*

1. *A high standard of esthetic appearance.* All of the amputees so far supplied with these arms continue to wear them, and, when carefully questioned, one of the chief reasons is that they "look well" (Fig. 12). To personnel in a sedentary type business occupation, as most of our small series are, this is a good reason. Acrylic is not the ideal medium, but it does set a high standard in this regard for future materials and improvements.

2. *The mechanical lever system* is simple and efficient, and effects a good useful range of strong finger movement.

3. *The locking device* permits of the prostheses being used in a passive manner. Long continuous gripping of objects—e.g. pen or knife—can be effected without continued muscle action. Metal clips on the common utensils are required to stabilize the grip by the nonresilient acrylic (Fig. 12).

4. *Total weight* of recently completed prostheses with all accessory fittings is 1 pound

8 ounces. This is much lighter than the dress arm normally supplied.

5. *The hand is durable and serviceable* despite a highly esthetic and somewhat fragile appearance. These hands have given little trouble in our small series to personnel outside the manual laborer class.

*The chief disadvantage* of the prosthesis is the limited effective range of the finger movement (only 1½ inch). This is dictated by the space available for the lever system. We consider this may be improved by modifying the lever system and using a "knuckle joint" or a "sliding plane" in the thumb system, if not in the opposing finger system as well.

#### RESULTS

Our experience of cineplastic amputations is confined to the forearm and that limited to 12 cases. It is recognized that only by a large case series carefully controlled over a long period could any finite conclusion be made, but in view of the times and our early encouragement, we consider such an interim statement indicated, immature though it is. All patients fitted with a cineplastic prosthesis continue to wear them to date, and remain enthusiastic. That must be the ultimate judgment of their value. Kessler in America states that 60 per cent of the 264 cases continue routine use of their prostheses. Jottkowitz quotes 40 per cent of his 728 cases, while in the Saurbruch clinic, 60 per cent of 304 cases are recorded as satisfied.

Careful preselection of cases must be made the prime factor for the success of any cineplastic procedure. No procedure would be more doomed to failure by any haphazard or mass application. All types of upper arm prostheses have their limitations—a cineplastic is one of them. Some individuals may be of such mental caliber or vocation that they would be better without any prosthesis at all. Some may be better suited to a bucket with attachments; others may require only a cosmetic substitute, or may need and derive great benefit and help from a cineplastic prosthesis.

A cineplastic prosthesis is not something automatic, but something of, which the wearer must learn the true use himself. Cine-

<sup>1</sup>In recent models, these cups have been made of reinforced acrylic, as shown in Figure 6. Polyvinyl chloride may be a still better medium for this purpose.



plasty is no proposition for a flabby personality. In the preselection of cases, the chief considerations are:

*The individual, his attitude, and will.* He must be fully informed of the implications of the procedure, and its limitations. The early expectations of upper limb amputees are often too great. The salesmanship of a manufacturer or town gossip may contribute to this mistake, which should never be allowed to continue for any lack of careful explanation. Sad realization of the gross inadequacy of an artificial arm when supplied as compared with that of his hopes, has—in the past—often led not only to its rejection, but to a deep-rooted prejudice for any appliance. An amputee can always escape in an unfortunate sense of honor to have lost an arm and to show it.

*Type of work or vocation.* Forearm cineplasty is most satisfactory for a sedentary type occupation. It is of little use to the manual laborer for his work, but even he may value it in sedentary life and leisure. It is not incompatible with the alternate use of other limbs and appliances on the same stump.

*The amputation stump.* Prerequisites in this regard have been set out. There must be adequate length of forearm to permit a satisfactory cineplastic operation. We have had no experience with upper arm cineplasty, but the prosthetic technical difficulties associated with it must range against its relative value.

*Site of amputation relative to dexterity.* All right-handed amputees or their left-handed counterparts who are missing on the same side, would be better considered for a cineplasty than those missing on the opposite side. The bilateral amputee would seem always the strongest indication for cineplasty.

#### CONCLUSION

We believe with modern progress both in plastic operations and a better order of prosthesis, that cineplastic procedures as described must have a wider application than we know of at present.

It is hoped that our experiments and results might stimulate trial on a larger scale than our numbers, time and facilities might permit.

There are many ex-service personnel who have lost their right hands in the service of their country and their fellows, and their least dessert is the pan-ultimate that modern science and surgery can contribute to their re-construction.

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# THE EFFECT OF PULMONARY RESUSCITATIVE PROCEDURES UPON THE CIRCULATION AS DEMONSTRATED BY THE USE OF RADIOACTIVE SODIUM

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IN asphyxia, the object of all resuscitative procedures is to produce an adequate pulmonary ventilation. Negovski and his co-workers have recently added to pulmonary ventilation, the intravascular injection of oxygenated blood and glucose in their efforts at "revival" (1). The majority of investigations in resuscitation have dealt with the degree and efficiency of the ventilation produced by the various methods. Such ventilation occurs as a result of: (a) inflation of the lungs and return to the starting point; (b) deflation of the lungs and return to the starting point; (c) alternate inflation and deflation of the lungs. The procedures are classified as manual or mechanical, and are of various degrees of efficiency. A measured and constant amount of ventilation can be produced only by mechanical means, controlled by either a constant volume or a constant pressure. Large volumes or excessive pressures may cause alveolar rupture and for this reason controlled pressures are safer than controlled volumes. Only resuscitators with a controlled pressure should be used. No control or constancy exists with any manual method.

Pulmonary ventilation alone is insufficient to produce resuscitation, particularly when circulation has stopped. Oxygenated blood in the lungs is of no value unless it can be moved out and transported to the vital centers of the nervous system. Such a movement of the blood does take place in certain methods of resuscitation, varying in rate and volume with the method used.

Very little emphasis has been placed upon this aspect of resuscitative procedures, and no definite study appears to have been made of it. Actually, until recently there has been no satisfactory way of demonstrating whether or not any given procedure could produce an actual movement of the blood column. The purpose of the present paper is to describe a method for determining the relative effects of various types of pulmonary resuscitation upon the circulation, and to give some experimental results obtained thereby.

This method consists essentially in introducing a tracer substance into the vascular system of an animal immediately following death by asphyxiation and recording any movement of this substance during the application of the resuscitative procedure. The tracers which have been employed are radioactive sodium, fluorescence, and oxygen. This concerns the use of radioactive sodium only.

The use of artificially radioactive isotopes as tracers has become rather familiar in the field of experimental medicine in recent years. Sodium, used in the present study, is made radioactive by deutron bombardment in the cyclotron and then emits penetrating radiations which can be detected by means of a Geiger-Mueller counter. A small amount of this material, in normal saline, injected into the circulatory system of the living animal, is rapidly carried throughout the body; its presence in any region can be demonstrated by placing the counter against the surface of the body at that part (2). In an animal whose circulation has ceased, such distribution could not occur. A counter placed over the body at a place distant from the site of injection would register only a small background count, due

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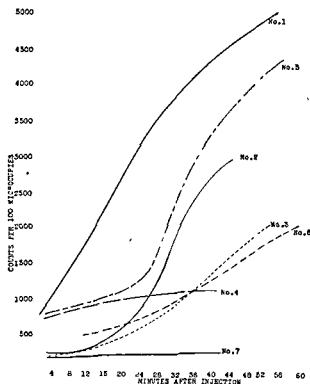


Chart 1. No. 1, Heparin, intravenous sodium, double action resuscitator; No. 2, heparin, intravenous sodium, double action resuscitator; No. 3, heparin, intra-arterial sodium, double action resuscitator; No. 4, no heparin, intravenous sodium, double action resuscitator; No. 5, heparin, intravenous sodium, suction only; No. 6, heparin, intravenous sodium, pressure only; No. 7, control, heparin, intravenous sodium, no resuscitator.

to the presence of the sodium in the distant region. As long as the radioactive material remained essentially at this position, the count would remain the same. If, however, any movement of the blood in the veins and arteries could be brought about by a resuscitative procedure, the radioactive sodium would also be moved, and any appreciable shift toward the counter would be demonstrated by an increase in the counting rate.

#### TECHNIQUE

Dogs 14 to 20 kilograms in weight were used, the following procedure being carried out: The animal was anesthetized with intravenous or intraperitoneal nembutal. An endotracheal tube with occlusion cuff was then inserted and the cuff inflated to make the tube leak-proof. To prevent intravascular clotting of the blood, 2 to 5 cubic centimeters of

heparin were injected intravenously. Approximately 5 minutes after the injection of heparin the endotracheal tube was completely clamped off, and the animal allowed to succumb to obstructive asphyxia. Cardiac cessation and death according to clinical evidence took place about 8 to 10 minutes after the tube was clamped. However, in order to insure complete death with no subsequent cardiac activity, the tube remained clamped for an additional 20 to 30 minutes. The animal was placed on an inclined plane, with the head elevated about 20 degrees, to counteract any possible effect of gravity in causing diffusion of the tracer substance toward the heart.

At the end of this time about 2 cubic centimeters of normal saline, containing 50 to 60 microcuries of radioactive sodium were injected into a femoral vein or artery. The Geiger-Mueller counter was placed against the neck of the dog, in proximity to the carotid artery, and the resuscitative procedure started and carried on for 40 to 60 minutes.<sup>1</sup> During this period, starting at the instant of injection of the radiosodium, the counts per minute registered by the counter against the neck were recorded. These counts were plotted on a curve showing any change in counting rate with time after the start of resuscitation (Chart 1).

After the mechanical procedure had been carried on for this period, and the effect was evident, the resuscitator and counting were stopped and 5 cubic centimeter blood samples taken from the femoral vein and artery on the opposite side from that injected, the right and left side of the heart, the jugular vein, and one carotid artery. Careful measurements were made of the amount of radioactive sodium contained per cubic centimeter of each of these samples (Tables I and II).

Experiments were carried out with various possible combinations of conditions:

Intravenous sodium with (a) alternate inflation and deflation of the lungs; (b) inflation and release; (c) deflation and release.

Intra-arterial sodium with (a) alternate inflation and deflation.

<sup>1</sup>The resuscitators used positive pressure of plus 14 millimeters of mercury, negative pressure of minus 9 millimeters of mercury. The rate was set at 16 to 20 per minute.

TABLE I.—RADIOIODINE CONTENT OF DOGS' BLOODS

No. of experiment	Weight of dog kgm	Type of resuscitative procedure and site of injection	Assumed blood volume c. c. (1/7 weight)	Microcuries radioiodine injected	Microcuries per c. c. if entire dose were uniformly distributed*
1	10.5	Intravenous sodium Heparin Double action respirator	2790	50	0.018
2	18.7	Intravenous sodium Heparin Double action respirator	2670	50	0.019
3	16.1	Intra-arterial sodium Heparin Double action respirator	2300	50	0.022
4	20.8	Intravenous sodium No heparin Double action respirator	2970	60	0.020
5	16.5	Intravenous sodium Heparin Suction only	2360	60	0.025
6	16.9	Intravenous sodium Heparin Pressure only	2410	60	0.021
7	11.8	Intravenous sodium Heparin No respirator	1970	50	0.025

\*Actually some of the sodium would have passed into the extravascular fluid, so this value is probably somewhat high.

Controls, with intravenous sodium with (a) heparin with no resuscitative procedure; (b) alternate inflation and deflation with no heparin.

#### RESULTS AND DISCUSSION

A heparinized animal recently succumbed to obstructive asphyxia provides an ideal subject for observing the effect of any given resuscitative procedure upon the circulation, provided a tracer can be introduced into the blood so that its movement can be followed. Any such movement would depend on the fact that the mechanical inflation and deflation of the lungs produce a regular filling and

emptying of the pulmonary capillaries and a regular alternation in pressure upon the heart and great vessels of the mediastinum. Since the valves of the heart and veins prevent a back flow of blood, any movement of the circulation must be in one direction, and if of sufficient rate and volume would complete the circuit from left heart to artery, to capillary, to vein to right heart, to lungs, and thence back to left heart again. Such movement of blood containing radioactive sodium could be detected by the Geiger-Mueller counter, its rate recorded, and some idea obtained of its volume.

TABLE II.—RADIOIODINE CONTENT OF BLOOD SAMPLES, IN PERCENTAGE OF CONTENT FOR UNIFORM MIXING OF ENTIRE ADMINISTERED AMOUNT

No. of Experiment	Opposite femoral artery	Opposite femoral vein	Carotid artery	Jugular vein	Right auricular appendix	Left auricular appendix
1	17	28	22	22	22	33
2	63	42	63	21	37	58
3	59	0	50	14	50	50
4*						
5	16	80	16	150	160	12
6	38	210	0	0	33	33
7	Trace	Trace	0	0	0	0

\*No samples could be taken from this dog having no heparin

The experimental data for 7 dogs are shown in Chart 1. Animal 7, the control with no resuscitative procedure but with heparin and radioactive sodium, showed no increase in count at the neck during 40 minutes. This demonstrates that there is no significant motion of the sodium due to diffusion or any other process occurring when no resuscitator is employed. In animal 4, the control having no heparin, the count rose only very slightly. On postmortem examination a large clot was found in the abdominal inferior vena cava, which would have prevented any further passage of radioactive sodium beyond this point. With all of the other animals, after a short period the count began to increase, and continued to rise as long as it was followed, up to an hour. In all except animal 2, there was a delay of 15 to 20 minutes before definite change was evident; this one animal showed an immediate rise and went much higher than any other. The reason for this is not evident; there seemed to be no doubt that the dog was dead, although an extremely weak heart action would account for the finding.

With the exception of animals 1 and 2, each one was subjected to a different procedure from all the others, so that there is no data as to possible variations among animals treated in any one particular manner. Hence it is not possible to put much stress on the numerical differences in the results. However, the two dogs in which alternate inflation and deflation were employed (animals 1 and 2) and the one having deflation and release (animal 5) showed values definitely higher than the others. The one having inflation and release (animal 6) came up more slowly, as did the one in which the injection was intra-arterial (animal 3). This latter was to be expected, since the material would have to be moved first through the capillaries and then into the veins before it could start toward the heart.

The radiosodium contents of the blood specimens from the various dogs are given in Table I, with other pertinent data. It is assumed that the blood is 7 per cent of the body weight, and microcuries per cubic centimeter are calculated for uniform distribution throughout the circulatory system. This

amount is what would be expected in a living dog, when mixing through the blood was completed, before diffusion into the extravascular fluid had proceeded to any significant degree. In none of the asphyxiated dogs was this distribution approached.

Certain suggestions may be advanced to explain the results in the various animals, but it must be recognized that these are tentative and could be confirmed only by repeating each test on several dogs of essentially the same weight. For instance, in animal 3, having intra-arterial sodium, apparently the procedure was not carried on long enough for the material to travel through the capillaries of the injected leg to the veins, to the heart, to the artery of the opposite leg, and through the capillary system of the opposite leg to the vein, for no active material was found at that site. Similarly it was low in the jugular vein. However, the variations in values in all the examinations indicate that the mixing of the radiosodium in the blood is far from uniform, as would be expected with this type of forced circulation. The actual radiosodium contents of the blood samples may not have much significance. The important thing is that grossly, with the counter, general movement in the circulation can be observed.

From these experiments it is quite evident that in a dead animal the mechanical inflation or deflation of the lungs or a combination of both produces a movement of the blood of sufficient magnitude to circulate it over the entire body, in a continuous direction from vein to heart, to lungs, to heart, to artery, to capillary, and back to vein again. While both the rate and the volume of this circulation are well below that in the living animal, it is, nevertheless, definite. Whether it is a result of the alternate filling and emptying of the pulmonary capillaries or of alternation in pressure upon the heart and great vessels, or a combination of both, is not yet determined (3).

That it is possible by mechanical means to circulate the blood in an animal whose heart has stopped beating would seem to have considerable clinical value. In order for the blood to be circulated it must remain fluid. Intravascular clotting takes place soon after death, and when this occurs the possibility of recov-

ery is terminated. Therefore the use of heparin intravenously as an active part of resuscitation is indicated. If, in resuscitation, heparin is given intravenously before the heart has stopped beating, thus preventing clotting, the time of possible revival is prolonged. Since the greatest amount of circulatory movement was found with alternating positive inflation and negative deflation of the lungs, this should be the method of choice. This can be done only by mechanical means; it is therefore evident that mechanical double action respirators are of the greatest value.

Because of the small number of experiments, no definite numerical conclusions can be drawn from these results. However, movement of the blood in a dead heparinized animal has definitely been shown to occur under the action of mechanical respirators. The results have been qualitatively corroborated by other experiments (to be reported later) in which fluorescence and oxygen have been used as tracer substances. Quantitative results are more readily obtained by use of a radioactive tracer.

#### SUMMARY AND CONCLUSIONS

A method of determining the effect of pulmonary resuscitative procedures on the circu-

lation by the use of radioactive sodium has been described. By this method it has been possible to demonstrate that alternate mechanical inflation and deflation of the lungs, or either operation alone, produce a movement of the blood within the vascular system. This movement is sufficient in the dead but heparinized animal to circulate some of the blood throughout the entire body. Mechanical resuscitators, using alternating positive and negative pressures, produce the greatest circulation. As soon as postmortem clotting occurs, little or no motion of the blood can be brought about by resuscitative procedures. When intravenous heparin is used to prevent this clotting, the period during which blood can be moved is greatly prolonged. For this reason the use of intravenous heparin seems indicated in resuscitation, as a definite means of prolonging the possible recovery time of the asphyxiated patient.

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# CANCELLOUS BONE GRAFTS FOR INFECTED BONE DEFECTS

## A Single Stage Procedure

Wing Commander HERBERT M. COLEMAN, M.D., F.R.C.S. (Ed.), Major JAMES E. BATEMAN, M.D., GORDON M. DALE, M.D., and Captain DONALD E. STARR, M.D.

THE skillful surgery of World War II, with the help of plasma, penicillin, and sulfa therapy has saved many lives and limbs which would otherwise have been lost. The reconstructive surgeon is subsequently faced with many difficult problems in the restoration of a limb. Large bone defects with scarring of the overlying tissues are frequently encountered after compound fractures or gunshot wounds. In cases in which the wound has never been infected or has been healed for several months, the problem is relatively simple and can be handled by one of the common methods of bone grafting. In those cases in which the bone defect has an associated chronic low-grade infection with sequestra and sinus formation, function must be restored quickly before infection and immobilization give rise to such disuse changes as stiff joints, atrophy, and fibrosis of muscles, together with circulatory changes.

In January, 1944, Dickson stated that, "a surgical bone graft should not be attempted in the presence of active infection even if low grade. An occasional success does not justify the risk of almost certain failure to be anticipated." "Placing a bone graft in an infected area, therefore, must be characterized as surgically unsound and a violation of the principles of bone graft surgery." In the series under review over the past 14 months, 52 infected bone defects have been cleaned out, filled with cancellous chip grafts and the wounds closed without drainage. This procedure, in direct violation of the principles here enumerated, has yielded results which are extremely gratifying. In only 4 cases has the result been unsuccessful with continued infection, resulting in sequestration

of the grafts or further sequestrum formation in the grafted bone. The remaining 48, or 92 per cent, are healed with the bone defects obliterated.

In the summer of 1944 several patients were admitted with sinuses leading down to large cavities in the upper end of the tibia (Figs. 1, a, b, c; 3, a, b, c; 12, a, b, c, d.). The defects were such that they could not be dealt with in the usual manner by saucerization or filling with muscle grafts. This type of osteomyelitis had been a problem after the last war, and many of them eventually came to amputation (Fig. 2). Visits to other orthopedic centers found these patients being treated from month to month with courses of penicillin or sulfa drugs without effect.

In view of good results following sequestrectomy with closure of wounds under penicillin and the successful use of chip grafts in the mandible by the plastic surgeons in the presence of infection, it was our opinion that cancellous grafts could be used in other bones as well. Mowlem (6, 7) has reported 85 cancellous chip grafts. Eleven of these were done in the presence of infection, 2 in the tibia and the rest in the mandible and skull. He considers fragmentation of the graft provides a greater surface through which transplanted bone cells become accessible, first to serum and then to newly formed capillaries, thus making their survival more certain. We have confirmed his observation that cancellous bone has an unusual degree of resistance to infection. Whether the grafts die and are re-placed or go on living, as Mowlem states, is difficult to say from x-ray evidence. What the process may be, the fragmentation results in rapid new bone formation. We have noted the new cortex formation which he describes (Fig. 13c). In 5 instances, ununit-

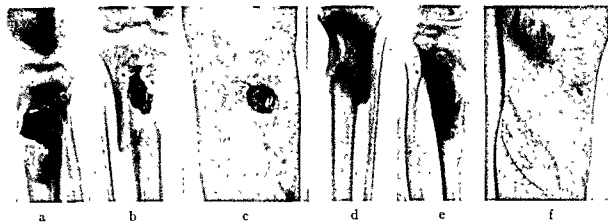


Fig. 1.

Fig. 1. Case 3, H. W. a, b, c, A large defect in the upper tibia filled with lipiodol. From this cavity *Staphylococcus aureus* and *Bacillus proteus* were cultured. At one sitting the cavity was cleaned out and filled with cancellous bone chips. d, e, f, The same case 4 months later with the cavity consolidated and the wound healed. The patient has 90 degrees of knee movement. The apparent sinus in f is only a retraction of the scar at this point.

Fig. 2. Three examples of traumatic osteomyelitis with cavity formation which came to amputation after World War I.

Fig. 3. Case 6, J. C. Gunshot wound of tibia. a, b, c, Show the condition on admission. The sinus was infected with hemolytic *Staphylococcus aureus*, and *Aerobacter aerogenes*. Note the ununited fracture of tibia, and the sequestra. The fracture was united in 2 months. f, The condition of the wound at the first change of plaster. d, e, g, Final result.



Fig. 2.

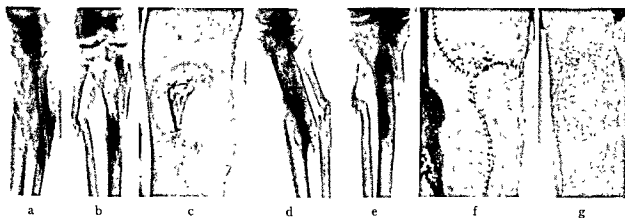


Fig 3

linear fractures were present in relation to a defect and united rapidly after grafting. Two of these in the tibia were united in 2 months (Figs. 3, a, b, c, d, e, f, g). In two instances complete defects were present. One of these

was solid enough for weight bearing after 7½ months, and the patient has been on full activities for 5 months. The other case (Fig. 4, a, b, c, d) is solid at 6 months with obliteration of the defect.



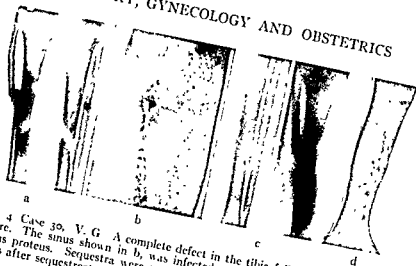


Fig. 4 Case 30. V. G. A complete defect in the tibia following a compound fracture. The sinus shown in b, was infected with *Staphylococcus aureus* and *Bacillus proteus*. Sequestra were present in the defect. The tibia was solid 6 months after sequestrectomy with cancellous bone grafting, as shown in c and d.

#### TECHNIQUE OF OPERATION

*Preoperative and postoperative care.* The patient is started on 20,000 units of penicillin intramuscularly every 3 hours, 2 days before operation. This is continued postoperatively until his temperature has remained normal from 2 to 5 days. At operation a pneumatic tourniquet is used to ensure a dry field. This is essential for complete sequestrectomy. Any sinus is injected with methylene blue so that no infected tissue will be left behind. All scar tissue, granulation tissue, and sequestra are removed. The cavity is excised with an osteotome or curetted down to healthy bleeding bone. Where feasible, a block resection of the bone defect is done. The wound is washed out with saline, and penicillin sulfathiazole powder, 100,000 units to 20 grams, is sprink-

led liberally during the operation to ensure that all exposed tissues are protected. The periosteum is stripped as little as possible.

The grafts are taken from the anterior portion of the iliac crest by an assistant and the two fields are kept separate. Both iliac crests are prepared, as the full extent of the cavity cannot be determined from the x-ray picture and is usually much larger than expected. The posterior iliac crest has also been used. The crest is exposed with as little stripping of the periosteum and muscles as possible. The contour of the ilium is maintained. The cone of cortical bone with attached periosteum is raised from the crest of the ilium. A wedge of cancellous bone (Fig. 5) can then be cut and further bone obtained with a curette. The wedge of cancellous bone is shaved with a sharp osteotome into thin chip grafts. All bone. This is essential as cortical bone has less resistance to infection (Figure 11, a, b, c) demonstrates this point. A previous chip graft was done in England using cortical and cancellous bone from the tibia. The graft was unsuccessful and the cortical sequestra can be seen in the roentgenogram (Fig. 6, a). Cancellous chip grafting was successful (Fig. 6, b and c).

The chips are mixed with the penicillin sulfathiazole powder and packed loosely into the cavity. The bone edges are bevelled and overlapped with chips to increase the surfaces in contact. One of us (J. E. B.) fills the cavity

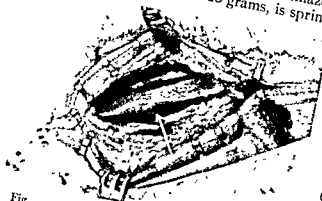


Fig. 5 The anterior iliac crest is here exposed. The arrow points to the wedge of cancellous bone ready to be lifted out.

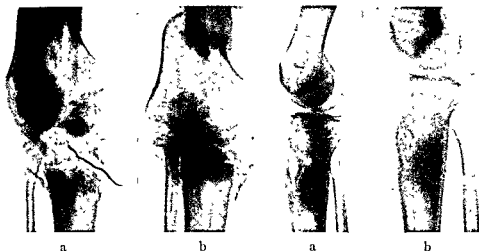


Fig. 6.

Fig. 6. F. D. a, A defect of the upper tibia involving the knee joint, infected with *Bacillus proteus*. A one stage sequestrectomy and arthrodesis with insertion of cancellous bone grafts was done. b, The knee was soundly arthrodesed 4 months later.

Fig. 7. Case 2, J. Mc. a, An abscess of the upper tibia from a blood-borne infection in childhood. A sinus was present infected with *Staphylococcus aureus*. b, Three months after filling the defect with cancellous bone. There has been no recurrence of infection 14 months later.

Fig. 7.

with chips and penicillin powder held together with coagulated autogenous plasma. One to 2 cubic centimeters of .02 per cent sterile agar is added as a coagulant. This produces a vehicle of jelly-like consistency fixing the sulfathiazole and penicillin to the fragments. The time of absorption of the penicillin and sulfathiazole is prolonged and the plasma produces more concentrated nourishment for the grafts than blood clot. The skin defect is then closed. If more than a simple plastic procedure is necessary, the operation is completed by a plastic surgeon. The limb is enclosed in a plaster-of-Paris cast, which is not changed for 3 weeks. Soft tissue immobilization is important for healing and the limb must be immobilized until the grafts are consolidated.

This report is necessarily a preliminary one, as the series covers just over a year and many of the cases have been done in the past few months. The final fate of the grafts will have to be evaluated, but to date they have formed good bone with no evidence of absorption with use.

**Site of defect.** The tibia was involved in 29 cases, the femur in 12, the os calcis in 3, the humerus in 6, the carpus in 2.

In all 52 cases infection was present at the time of operation. Preliminary sequestrec-

tomy was done by us in 6 of these, and many had had a previous sequestrectomy which had not been successful, as sequestra still remained. Three plates, a screw, wire, and numerous foreign bodies were also removed. Sequestrectomy was not done as a separate operation unless the patient was being anesthetized for a preliminary plastic procedure and the defect was readily accessible. In bones clothed by muscle, the extra opera-

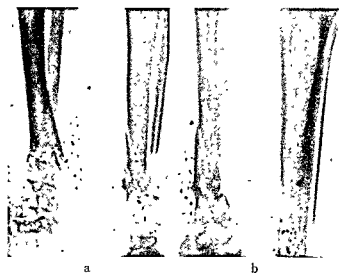


Fig. 8. Case 28, P. G. A compound fracture of tibia infected with *Staphylococcus aureus*, diphtheroid and *Bacillus proteus*. A caterpillar graft was completely lost, but did not affect the take of the cancellous bone grafts as shown in, b.

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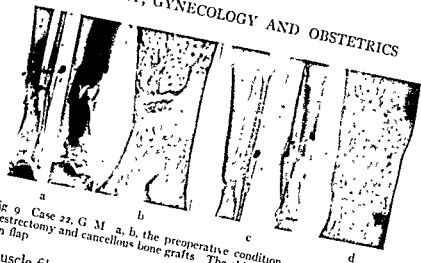


Fig. 9. Case 22, G. M. a, b, the preoperative condition. c, d, 4 months after sequestrectomy and cancellous bone grafts. The skin wound was closed by a rotation flap.

tion will increase muscle fibrosis. In the tibia it is likely to increase the skin defect and make subsequent wound closure more difficult. We do not consider that there is anything to be gained by a preliminary sequestrectomy, as the granulating cavity must be curetted again before insertion of the cancellous grafts. Sequestrectomy with preliminary split skin grafting of the cavity which has recently been described (4, 5) would appear to be an unnecessary procedure, with far from assurance of a complete take of the skin grafts and no assurance of the eradication of the infection in the time which elapses before the final bone graft is carried out. Sterilization of the wound is obtained by the complete excision of all infected scar, granulation tissue and diseased bone with the aid of penicillin and sulfathiazole. Any failure in the take of the split

skin graft leaves a portal of entry for further infection.

CAUSE OF INJURY AND SOURCE OF INFECTION  
The cause of injury and source of infection were as follows:

- |   |   |    |
|---|---|----|
| 1 | Gunshot wounds involving bone                               | 45 |
| 2 | Compound fractures  | 3  |
| 3 | Bone infection following open reduction of simple fractures | 3  |
| 4 | Bone abscesses from childhood osteomyelitis                 | 2  |

The 2 cases of bone abscess from a blood-borne infection in childhood had had recurrent acute attacks, and both were infected with *Staphylococcus aureus*. Healing occurred without

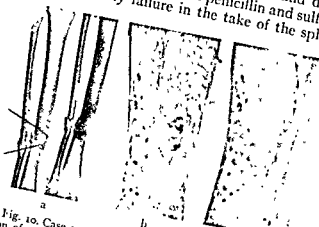


Fig. 10. Case 25, W. W. Infection following open reduction of a fractured tibia. a, b, Show the sinuses with sequestra formation. c, Tibia united and the wound healed, 4 months after sequestrectomy with cancellous bone grafts.

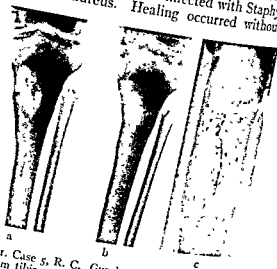


Fig. 11. Case 5, R. C. Gunshot wound of tibia. Bone chips from tibia were inserted in the defect in England. The cortical bone has sequestered, as shown in (b). He was admitted with a sinus from which *Staphylococcus aureus* and pyocaneus were cultured. b, The defect after cancellous bone grafts from the iliac crest. c, The wound healed by primary intention.

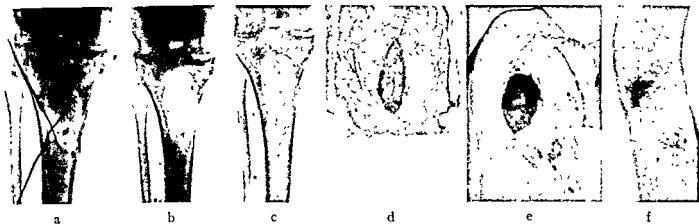


Fig. 12. Case 9, A. M. Gunshot wound of the left tibia with a large sinus and sequestra, a, d, b, e, The extent of the cavity after sequestrectomy took place. c, f, Final

consolidation of the cavity with the wound healed. There was a partial loss of the split skin graft over the donor area.

incident, and there were no symptoms, and the cavities were obliterated (Fig. 7, a, b).

Clostridium . . . . .	2
Alcaligenes . . . . .	1
Bacillus coli . . . . .	1

#### BACTERIOLOGY

In 21 instances, the infection was a mixed one. Penicillin was given to all patients routinely, despite the presence of penicillin-resistant organisms. Bacteriology in 10 cases was incomplete—either no growth was reported or no report was found. The organisms in their frequencies were:

Staphylococcus aureus . . . . .	17
Bacillus proteus . . . . .	11
Diphtheroid bacillus . . . . .	7
Pyocyanus (Pseudomonas) . . . . .	7
Hemolytic streptococcus . . . . .	3
Nonhemolytic streptococcus . . . . .	3
Escherichia . . . . .	3
Staphylococcus albus . . . . .	2
Aerobacter aerogenes . . . . .	2

In the 4 failures the organisms found were: In case 14, the *Staphylococcus aureus* (resistant to 30 units penicillin per 100 c.c.); in case 19 the *Bacillus proteus* and a clostridium; in case 29 the *Staphylococcus aureus*, *aerobacter*, *pseudomonas*, and *Bacillus proteus*; in case 51 the *Bacillus proteus*.

In these 4 cases, organisms resistant to penicillin were present and were undoubtedly a factor in the failure. In 3 of these further sequestra have been demonstrated, probably due to the interference with the blood supply of relatively avascular bone, plus continuing infection. The other failure was in a cavity surrounded by very sclerotic bone. The chip

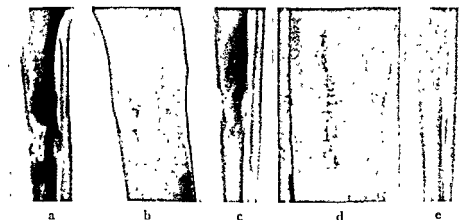


Fig. 13. Case 10, A. H. Compound fracture of tibia by a V-2 bomb. Patient was admitted with a sinus and sequestra, as shown in a, b, d. The wound healed at the first change of plaster. c, The cavity obliterated 3 months after sequestrectomy with cancellous bone grafting. e, Is a roentgenogram 11 months after cancellous bone grafts. Note the excellent quality of the bone with a new cortex formation.

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grafts were later removed and had sequestered with no evidence of osteogenesis. Poor blood supply to the grafts plus penicillin-resistant organisms resulted in failure. No virulent flare-up of infection has resulted from operation in any of the 52 patients.

## WOUND CLOSURE AND IMMEDIATE RESULTS

Extensive scarring and sinus formation were present in almost every case. This necessitated some form of plastic closure of the wound in 30 instances. The plastic procedures included local mobilization of the edges, rotation flaps, double-ended local pedicles, 2 abdominal pedicles, and 1 caterpillar flap. In some instances the skin was mobilized completely around the extremity over a wide area. In 33 cases the wounds were perfectly healed at the first change of plaster. Of the remaining 19 all are healed except 2.

The causes of failure of the wounds to be completely healed at the first change of plaster were: persistent sinus to bone in 5, loss of flap or a portion in 3, superficial necrosis of skin edges due to tension in 8, hematoma in 2, and stitch abscess in 1.

The 8 cases in which the superficial dry necrosis occurred could probably have been avoided with more careful closure. These all healed with no infection and minimum scarring. The loss of a flap or a portion did not affect the underlying cancellous grafts. In 1 case in which a complete caterpillar graft was lost (Fig. 8, a, b) the remarkable viability of cancellous chip grafts was demonstrated. None was lost and the cavity has consolidated. To date there has been no reopening of any wound or flare-up of osteomyelitis after healing.

In an additional series of 5 cases in which infected bone defects involved joints (Fig. 6, a, b), the same routine has been carried out. All of these are healed; 3 are firmly arthrodosed and the other 2 have been done too recently to expect arthrodosis.

## SUMMARY AND CONCLUSIONS

1. In 52 infected bone defects cancellous chip grafts have been inserted after sequestrectomy and the wound closed, with success in 92 per cent.
2. The method is applicable to traumatic osteomyelitis and some cases in which the infection has been blood-borne.
3. No virulent infections have resulted and there has been no flare-up of infection after healing, for periods up to 14 months.
4. In a small series in which traumatic osteomyelitis involved joints, chip grafts have been used after sequestrectomy with healing and satisfactory fusion.
5. Successful chip grafting in the presence of infection depends upon (a) complete sequestrectomy and removal of all infected tissue; (b) an adequate vascular bed for the grafts which must have all cortex removed; (c) no dead spaces, (d) penicillin, systemically and locally, with sulfathiazole, if indicated; (e) full thickness skin to close any skin defect; (f) plaster immobilization (for soft tissue healing and until the bone is consolidated).
6. The one stage method for obliterating infected bone defects saves months of hospital treatment and restores function before disuse changes become irremediable.

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## OUTLET PELVIMETRY

### A Commentary, and the Presentation of a Pelvimeter for Measuring the "Symphysis and Sacral Biparietal Distance"

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THE measurement of pelvic outlet diameters has always presented certain difficulties, whether the attempt to determine these dimensions has been by manual or roentgenological means. In the former case, because of a lack of definite palpable end points for the intertuberal or transverse diameter, the estimation of this dimension may be quite variable in the same individual even when measured by experienced observers. Roentgenologic methods for depicting the pubic arch have not proved very satisfactory because of distortion difficulties. Lateral pelvic views, nevertheless, are very useful in determining anteroposterior diameters and relationships. However, important morphological data can be obtained

by either method, manual methods being particularly valuable in determining the shape and general size of the pubic arch.

The pelvic outlet in relation to labor presents a mechanism which it is useful to consider. With a normally shaped pubic arch with adequate capacity the head extends with the occiput in close contact with the subpubic angle. The arc described by the extending sinciput is minimal under these circumstances and the likelihood of perineal damage is also minimal (Figs. 3 and 4).

However, when the subpubic angle is narrow and the capacity of the arch is thereby lessened, the head as a whole is forced backward, the biparietal diameter engaging the ischiopubic rami; the arc of the extending sinciput is lengthened, and the liability of soft tissue damage thereby increased. It is obvious, therefore, from the mechanics of

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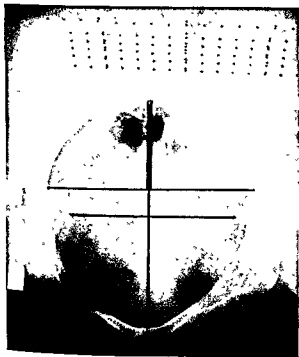


Fig. 1. Roentgenogram of pelvic inlet diameters as shown in Figure 8. (Correction scale at top.)

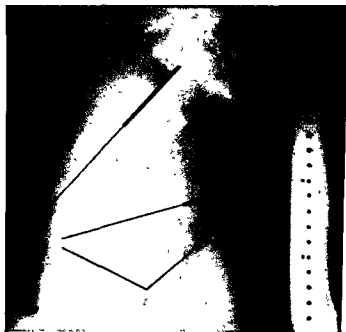


Fig. 2. Lateral roentgenogram diameters as shown in Figure 9. (Correction scale at side)

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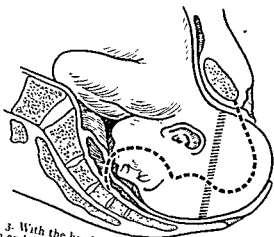


Fig. 3. With the head flexed at the perineum before extension and disengagement take place the occipital part of the head comes in contact with the pubic arch, meeting resistance at the parietal bosses (Fig. 4) (Modified from DeLee.)

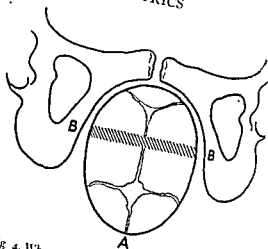
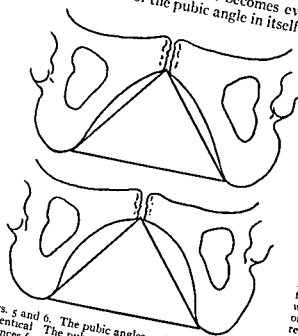


Fig. 4. When the fetal head begins to extend the parietal bosses meet resistance at B-B, and point A sweeps upward over the perineal floor. (Modified from DeLee)

these head and outlet relationships that the width of the subpubic angle and the shape of the pubic arch are of considerable importance. As Allen logically states, "The important point is clearly how close the occiput is allowed to approach the lower edge of the symphysis." If we consider variations in the downward course of the pubic rami, it becomes evident that the degree of the pubic angle in itself may



Figs. 5 and 6. The pubic angles and bituberal distances are identical. The pubic arches, however, have important differences from the obstetrical viewpoint.

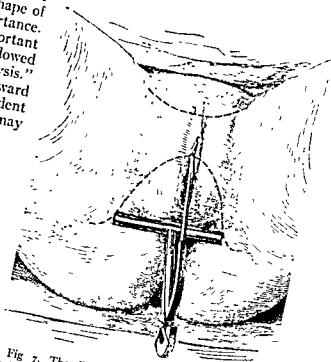


Fig. 7. The sliding crossbar of a Thoms outlet pelvimeter has been replaced by a solid bar 9 centimeters in length. After palpation of the arch this bar is brought to fit snugly between the rami. It is held in this position while the arm of the pelvimeter is placed at the lower edge of the symphysis. The symphysis biparietal distance is read from the scale. The sacral biparietal distance is measured by holding the cross-bar in position and swinging the arm posteriorly to the sacrococcygeal junction—1 centimeter is deducted from the reading to compensate for the thickness of the lower sacrum (Modified from Williams.)

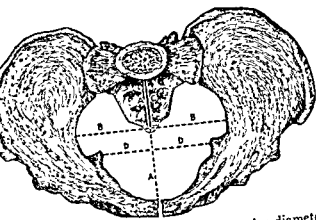


Fig. 8. The pelvic inlet: A, anteroposterior diameter, B, transverse diameter, C, posterior sagittal diameter, D, transverse diameter of midplane.

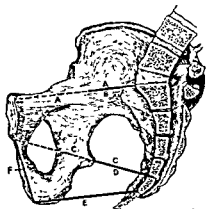


Fig. 9. Anteroposterior diameters seen in lateral aspect: A, anteroposterior diameter of inlet, B, posterior sagittal diameter of inlet, C, anteroposterior diameter of midplane, D, posterior sagittal diameter of midplane, E, sacral biparietal distance, F, symphysis-biparietal distance.

not give a good index to outlet capacity and may even be misleading. Figures 5 and 6 illustrate this point. In both instances identical pubic angles are shown with the same intertuberal diameters, yet the available space in the upper part of the two arches is quite different.

As an alternative to determining the subpubic angle and attempting to determine a transverse outlet diameter, the measurement of the symphysis-biparietal distance has been recommended by Allen. This is the distance within which a normal biparietal diameter cannot approach the lower edge of the symphysis. This author determines this dimension from a roentgenographic film, but I am convinced that equally good information can be determined adequately by the palpatory method here described. Because of the difficulties previously commented upon of measuring the bituberous diameter, I find myself quite in agreement with this same author, who says "The bituberous diameter between the inner surfaces of the ischial tuberosities has also been discussed previously and the conclusion was then reached that this diameter could not satisfactorily be measured by any method so far described. The diameter, furthermore, is not of great importance *per se*, except in so far as it represents the free posterior end of the pubic arch: contraction of the arch always means a reduction in the intertuberal diameter, and since the arch can be more accurately measured, there seems to be little point in measuring the bituberous." From the roentgenological determination of

the symphysis-biparietal distance. Allen recommends a special film using Chassard and Lapine's technique. He uses 10 centimeters as representing the normal biparietal distance, a figure slightly larger than the average of 93 millimeters given by Scammon and Calkins. In the pelvimeter here presented I have used a crossbar of 9 centimeters, allowing thereby about 0.5 centimeter for the thickness of the soft parts covering the pubic rami in their medial aspect.

#### METHOD

The patient is brought well down over the edge of the examining table in the lithotomy position; the arch is thoroughly palpated, by using both hands simultaneously as in the manner well described in textbooks. The course of the rami downward is noted, whether straight, moderate, or widely arcuate. The crossbar of the pelvimeter is then passed between the rami, and by upward pressure it is brought as near the symphysis as possible. As the crossbar is held in this position, the end of the arm of the pelvimeter is brought to the lower edge of the symphysis and the symphysis-biparietal distance read on the scale as shown (Fig. 7).

Another outlet dimension which should prove useful is the sacral-biparietal distance; that is, the distance from the lower terminus of the symphysis-biparietal distance, as described, to the tip of the sacrum. This can be measured externally with the pelvimeter or it can be determined satisfactorily on the lateral film used in the general pelvic survey. This is



## SURGERY, GYNECOLOGY AND OBSTETRICS

accomplished by measuring downward between the shadows of the descending pubic rami the symphysis-biparietal distance previously determined. From the lower terminus of this distance to the tip of the sacrum represents the sacral-biparietal distance. The author is aware that the shadows of the pubic rami do not lie in the same plane and that the mean distance between them probably does not exactly represent the sagittal plane of the body. However, if films are taken at a target-film distance of 36 inches as recommended, the error encountered would not be obstetrically significant. For a further discussion of this aspect of roentgen pelvimetry the reader is referred to the author's views published elsewhere (3).

It might be useful to consider the relationship of these proposed outlet dimensions to a general pelvic survey. Such a survey for determining the adequacy of the bony pelvis for childbearing should include roentgen and palpatory methods (4). The former should include two flat films, one showing the birth canal from above downward, from which certain inlet and midplane measurements may be determined, and a second film taken laterally from which certain inlet, midplane, and outlet measurements may be obtained. The importance of morphological characteristics should also be emphasized in any such survey and, in addition, the following pelvic measurements will give useful information (Figs. 1, 2, 8, 9):

Pelvic inlet—Anteroposterior, transverse, posterior sagittal diameters

Pelvic midplane—Anteroposterior, transverse, posterior sagittal diameters  
 Pelvic outlet—Symphysis-biparietal, sacral-biparietal distances

In conclusion, the author takes this opportunity to mention again that the technical cost of such a pelvic survey need be hardly more than many hospital laboratory procedures, and that the information thus obtained is so greatly useful that every primigravida woman should have its benefit.

## SUMMARY

1. Pelvic outlet pelvimetry at present is not satisfactory because transverse dimensions cannot be accurately determined.
2. The important information in a given case should reveal how close will be the approach to the lower edge of the symphysis of the biparietal diameter of the child's head as it passes through the pelvic arch.
3. This information may be secured by palpation, and with the pelvimeter here described.
4. The comprehensive pelvic survey should include inlet, midplane, and outlet dimensional information, by use of both palpatory and roentgen methods. Prognosis on the information so obtained should be solely the responsibility of the obstetrician.

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2. SCAMMON and CALKINS. Quoted by Allen E. P. *Brit. J. Radiol.*, 1943, 16:279.
3. THOMS, H. *Am. J. Obst.*, 1943, 46:133.
4. THOMS, H., and Wilson, H. M. *Can. J. Biol.*, 1944, 13:831.

# EDITORIAL

## SURGERY Gynecology and Obstetrics

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SEPTEMBER, 1946

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### THE ABSORBABLE HEMOSTATIC AGENTS

THE absorbable hemostatic agents which have been recently developed, such as fibrin foam, oxidized cellulose (cellulosic acid), and gelatin sponge, represent a helpful contribution to the technique of surgery. Until these materials became available, muscle had been used as a hemostatic agent by the neurosurgeons since its introduction by Cushing in 1911. Most of the clinical experience with these new hemostatic agents, especially the fibrin foam and gelatin sponge, has been in neurosurgery. These reports have stimulated an interest in utilizing these materials to meet the varied problems of hemostasis in general surgery. Enough data are now available and more will soon be published which establish the usefulness of these agents in the broad field of surgery.

The fundamental mechanism involved in the use of the hemostatic agents is to hasten

the formation of a clot and give structural support to the clot. This permits control of hemorrhage of a greater magnitude than could be expected from the normal protective mechanism—the physiological process of the clotting of blood. In using hemostatic agents one is merely enhancing the value of a protective mechanism of the body.

The particular field of usefulness of the hemostatic agents is in the control of hemorrhage where ligature or suture is not adequate or feasible. *There is no place for controversy over the matter of using these materials in lieu of ligature or suture* in the ordinary routine technique of surgery.

In dissecting away scar tissue, freeing adhesions, or in mobilizing large flaps one may have a continuously oozing surface which may be difficult to control except by these agents. In the first aid treatment of hemorrhage from surface wounds, especially from large veins, these materials should be very helpful as a temporary expedient until the patient can be cared for in an adequately equipped operating room. In hemorrhage from parenchymatous organs, such as in wounds or resections of the liver, there is a place for better hemostasis than can be obtained by ligature or suture alone. This is also true for the bleeding from the under surface of the liver after cholecystectomy.

One may encounter a sudden venous hemorrhage during the course of an operative procedure, such as in the mobilization of an organ or tumor, where the bleeding point cannot be identified for application of a hemostat because of the massive bleeding or the inadequacy of the exposure. In such trying situations the hemostatic agents offer an alterna-

tive to the blind application of hemostats which may damage adjacent vital structures or fail to prevent exsanguination. It has been customary in the past to resort to large gauze packs in an attempt to control such bleeding. When these packs are subsequently removed one may again encounter hemorrhage. In using the absorbable hemostatic materials one does not have to contend with this problem.

In operations on the bile ducts or in resections of the pancreas one may open the portal vein. If vein suture is not feasible the only alternative is ligation, which of course is most undesirable. In such circumstances, as well as in injury to other veins which one may not choose to ligate and where vein suture may not be feasible, the hemostatic agents may offer an alternative which may prove most helpful. In an experimental study one of these agents has been used to control hemorrhage from the vena cava of animals by the application of a "patch" such as is used by the neurosurgeons in dealing with hemorrhage from the dural sinuses. It is desirable in this "patch" technique on veins to cover the hemostatic agent with a layer of tissue such as the peritoneum or pleura to prevent dislodgment even though the "patch" may become quite firmly adherent to the vein within twenty to thirty minutes. If vein suture is feasible in an injury to a large vein there is also a place for the hemostatic agents as a secondary line of defense against leakage and hematoma formation.

Only a few of the situations where the absorbable hemostatic agents may be helpful have been outlined. The entire field of surgery abounds with problems which may be aided by these materials. For example, experimental studies are being conducted to ascertain their usefulness in the control of hemorrhage from the heart and the aorta where they may possibly have some value.

The several hemostatic agents have different physical properties and some variation in the rate of absorption. The fibrin foam and the gelatin sponge are similar in that they are a spongy material. The oxidized cellulose has the texture of ordinary gauze or cotton. In the dry state the fibrin foam is brittle and easily fragmented, whereas the gelatin sponge can be compressed by the fingers into a pliable sheet. The fibrin foam may be slightly stronger than the gelatin sponge when moistened. Under favorable conditions the fibrin foam or the gelatin sponge undergo absorption within about four to five weeks. The oxidized cellulose is absorbed more rapidly. In the presence of infection the gelatin sponge may become liquefied and disappear within a few days to a week. When oxidized cellulose comes in contact with blood it turns brown and then black. Fibrin foam or gelatin sponge take on a pink or red color when blood is taken up by the myriads of interstices.

There is as yet relatively little information to guide one in the selection of the agent best suited to a particular hemostasis problem in general surgery. As more clinical and experimental data become available it may be possible to work out a recommendation to cover the various situations in which one hemostatic agent may have more value than another.

There will undoubtedly be other absorbable hemostatic agents developed which may have properties that will be more useful for some of the hemostasis problems than the material now available. There is a place for a tougher and stronger spongy material as well as a place for a more rapidly absorbed spongy or foamy material, and possibly a more slowly absorbed material than is now at hand. This brings up the point that some official supervision should be given to the manufacture of the hemostatic agents so that standardization of absorption properties and sterility controls can be estab-

lished. It would be appropriate for a committee of the American College of Surgeons to make some recommendation on this.

Technical points which can best be described as "know how" but which cannot be easily put into words or diagrams, are essential for the successful use of these materials. One must gain some personal experience in handling these agents before attempting to use them for the control of a severe hemorrhage. The most important general feature of the technique of applying these materials is to permit fresh blood to soak into them and then apply firm even pressure over the bleeding area for from three to five minutes or longer, depending on the magnitude of the hemorrhage and the structure from which it comes. In some instances the hemorrhage may be controlled in less than a minute.

Thrombin solution has been used with these hemostatic substances to hasten the clot formation. Those who have used the fibrin foam and the gelatin sponge recommend soaking these agents in the thrombin solution before applying to the bleeding area. Some have used thrombin solution for soaking the oxidized gauze before use. According to one who has had the widest experience with oxidized cellulose the thrombin is not necessary or even desirable, as the best hemostatic effect is obtained by applying the material in the dry state. This is apparently due to the slightly acid reaction of the oxidized cellulose. Thrombin has been found to be ineffective in an acid medium. If one uses an alkaline solution for the sake of the activity of the thrombin, the particular hemostatic action of the cellulose which is a property of the acidity of the material is thereby negated. Some recent experimental work with gelatin sponge has demonstrated that it has excellent hemostatic properties *per se*. It may be used by soaking only in a physiological saline solution, and then ex-

pressing the excess saline. It may also be used in the dry state if it is first compressed in the fingers until it becomes pliable. If there is any defect in the normal clotting mechanism, such as a deficiency in prothrombin or platelets, it would be necessary to use a thrombin solution. In spite of this evidence on the hemostatic properties of the sponge without thrombin, it would probably be preferable to continue using the thrombin solution with gelatin sponge until further studies clarify the effectiveness of the thrombin in the hemostatic action of these materials.

When pressure is applied to these hemostatic agents after they have been saturated with fresh blood there is a tendency for the spongy material to adhere to the tissues to which it is applied, thus sealing off the hemorrhage. If the blood clots in the spongy material before the pressure is evenly applied or if a hematoma develops under the material it does not tend to adhere firmly and the bleeding may not be controlled. Under such circumstances it is better to try a fresh sponge and attempt to get more even pressure over the bleeding area.

The one most important limitation to these absorbable hemostatic agents is that one should not expect to put large amounts of these materials into wounds, especially if there is contamination or infection present, without having some undesirable sequelæ. When any new substance is used in surgery there are bound to be misuses which may reflect unfavorably on the material. The fundamental principle of minimizing the amount of foreign material in a wound applies to the hemostatic agents as well as to anything else. Therefore it is important to minimize the amount of hemostatic agent used and especially to employ as thin a layer of the agent as is compatible with obtaining satisfactory hemostasis. Where there is a massive hemorrhage

which might otherwise be fatal, the amount of material used is of course a minor consideration. When there is trivial bleeding which might cause an undesirable but not necessarily fatal hematoma, then one must weigh the problem of the disadvantages of a foreign material against the disadvantages of a hematoma.

The hemostatic agents are still in an experimental stage of development and clinical use. However, they are destined to have an important place in the armamentarium of the general surgeon as they have had for the neurosurgeon, and will necessarily constitute

some part of the training program of the surgeon, the technical importance of which may be second only to the selection and use of ligatures and sutures.

The judicious use of the absorbable hemostatic agents will make for a greater degree of safety by minimizing blood loss in operative surgery, and furthermore may contribute to a widening of the scope of surgery, especially in the operative attack on malignant tumors in which the results being currently obtained by the accepted operative procedures on some organs leave much to be desired.

HILGER PERRY JENKINS.

# THE SURGEON'S LIBRARY

## REVIEWS OF NEW BOOKS

THE excellent monograph *Diseases of the Adrenals*<sup>1</sup> by Louis J. Soffer reviews completely the physiology and diseases of the adrenals. The chemical and mechanical techniques used in the diagnosis of adrenal disease, the recent methods used in studying the physiology of the glands, and the relation to other glands are discussed.

A detailed study is made of Addison's disease and of its treatment. The preoperative and postoperative treatment of surgical complications in Addison's disease are discussed. While pregnancy is strongly contraindicated in Addison's disease, the interruption of it is condemned as less safe than the attempt to carry it to termination. Advice is given for management.

The unusual sensitiveness of patients with Addison's disease to morphine, codeine, paraldehyde, bromides, barbiturates, insulin, thyroid extract, and thyroxin is emphasized. Epinephrine, sulfonamides, and penicillin may be used as in other patients.

An interesting paragraph is the summary of the experimental treatment of Addison's disease by transplantation of adrenal tissue. This should give successful results with improvements in transplantation technique, and would seem to be the ideal replacement therapy of the future.

The adrenogenital syndrome is also presented with critical discussion of virilism, Cushing's syndrome, adrenal cortical hyperplasia, and adrenal cortical tumors. The therapeutic measures include the use of various hormones, irradiation therapy to the pituitary and adrenals, and surgery.

The medullary and other extracortical adrenal tumors, especially the pheochromocytoma are adequately discussed in this monograph, and the preoperative and postoperative treatment of the various types of tumors are clearly outlined.

It is a well written, concise, and practical book with an exceptionally complete bibliography. It can be recommended to clinicians and all those interested in the physiology of the adrenals.

ARTHUR J. ATKINSON.

IN four hundred odd pages, illustrated by seventy-two well chosen plates, Guthrie's *A History of Medicine*<sup>2</sup> covers the history of medicine in a distinctly interesting fashion. The volume is well documented

with footnotes and a short list of authoritative publications follow each chapter. An appendix, containing a classified bibliography of medical history with a short evaluation of the more important ones, and a good index are included. Slightly more than half of the volume is devoted to the period ending with the 18th century. The 19th and 20th centuries are complete except that the author has chosen to leave for the evaluation of future historians the most recent advances in medicine and the work of those leaders who are still among the living.

While less exhaustive than Garrison's *Introduction to Medical History*, this volume has succeeded in combining broad philosophical discussion with brief biographical sketches in such a skillful manner as to encourage continuous reading. For the purpose of introducing the medical student to the study of medical history and for reviving the interest of the busy doctor in the fascinating story of medical progress, this volume is highly recommended. The experience of reviewing it has been a wholly enjoyable one.

THOMAS C. DOUGLASS.

THE second edition of *Clinical Electrocardiography*<sup>3</sup> by Scherf and Boyd is, as pointed out by the authors, primarily for the advanced student of electrocardiography and not for the beginner. It is well printed and there are only a few typographical errors. The electrocardiograms used as illustrations are numerous and for the most part satisfactory. Much of the text is used in discussing and explaining these cardiograms.

The authors adhere fairly well to the terminology recommended by the American Heart Association. They consider many clinical and controversial subjects and their approach to these subjects is stimulating. The discussion on interference dissociation and parasystole is well written. It would seem that more space could have been given to the subject of precordial leads and to coronary occlusion. The author's remarks regarding the changes incident to hypo-ovarianism will probably be challenged by some authorities.

This 259 page book is a definite contribution to the literature on this subject. It is to be recommended for the reference library of all physicians interested in electrocardiography.

JOHN A. MART.

<sup>1</sup>DISEASES OF THE ADRENALS. By Louis J. Soffer, M.D. Philadelphia, Lea & Febiger, 1946.

<sup>2</sup>A HISTORY OF MEDICINE. By Douglas Guthrie, M.D., F.R.C.S. (Ed.), F.R.S.E. With an Introduction by Samuel C. Harvey, M.D., F.A.C.S. Philadelphia, London, Montreal J. B. Lippincott Co., 1946.

<sup>3</sup>CLINICAL ELECTROCARDIOGRAPHY. By David Scherf, M.D., F.A.C.P., and Linn J. Boyd, M.D., F.A.C.P. 2nd ed. New York: J. B. Lippincott Co., 1946.

# CORRESPONDENCE

## THE Rh FACTOR—SEROLOGIC BACKGROUND AND CLINICAL APPLICATION.

—A Correction.

*To the Editor:* In the paper concerning the Rh Factor appearing in the June, 1946, issue of SURGERY, GYNECOLOGY AND OBSTETRICS, the sentence beginning on the eleventh line from the bottom of the

page, in the right column of page 744, is misleading in that it states: "An individual whose blood is Rh-negative and who carries both Rh-positive and Rh-negative genes is heterozygote." The sentence should, of course, begin "An individual whose blood is Rh-positive . . .", as the presence of Rh-positive genes inevitably means that the individual's blood must be Rh-positive.

S. MILES BOUTON, Jr.

## BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgement must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

**WILLIAM BEALMONT'S FORMATIVE YEARS. Two Early Notebooks 1811-1821.** By Genevieve Miller, M.A. New York: Henry Schuman, 1946.

**COMPRESIONES MEDULARES NO TRAUMATICAS.** By Rafael J. Babbini. Buenos Aires: Aniceto Lopez, 1943.

**JOHN AND WILLIAM HUNTER.** By Jane M. Oppenheimer, with a Foreword by Fenwick Beekman, M.D. New York: Henry Schuman, 1946.

**CANCER OF THE SCROTUM IN RELATION TO OCCUPATION.** By S. A. Henry, M.A., M.D. (Cantab.), F.R.C.P., D.P.H. (Cantab.). London, New York, Toronto: Oxford University Press, 1946.

**PERIPHERAL VASCULAR DISEASES.** By Edgar V. Allen, B.S., M.A., M.D., M.S., Nelson W. Barker, B.A., M.D.,

M.S., and Edgar A. Hines, Jr., M.D., B.S., M.A., M.S., with Associates in the Mayo Clinic and Mayo Foundation. Philadelphia, London: W. B. Saunders Co., 1946.

**QUICK REFERENCE BOOK FOR MEDICINE AND SURGERY.** By George E. Rehberger, A.B., M.D. 13th ed. Philadelphia, London, Montreal: J. B. Lippincott Co., 1946.

**MOTHER AND BABY CARE IN PICTURES.** By Louise Zabriskie, R.N. 3rd. ed. Philadelphia, London, Montreal: J. B. Lippincott Co., 1946.

**DIABETIC CARE IN PICTURES.** By Helen Rosenthal, B.S., Frances Stern, M.A. (Hon.), and Joseph Rosenthal, M.D. Philadelphia, London, Montreal: J. B. Lippincott Co., 1946.

**LES NEPHROPATHIES GRAVIDIQUES.** By H. Figeaud and H. Dumont. Paris: Massonet C<sup>ie</sup>, Editeurs, 1946.

**LE FIBRO-MYOME UTERIN.** By J. Ducuing. Paris: Masson et C<sup>ie</sup>, Editeurs, 1946.

**UROLOGIC ROENTGENOLOGY.** By Miley B. Wesson, M.D. 2nd rev. ed. Philadelphia: Lea & Febiger, 1946.

# CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

W. EDWARD GALLIE, TORONTO, *President*

IRVIN ABELL, LOUISVILLE, *President-Elect*

*Committee on Arrangements*

THOMAS E. JONES, *Chairman*; JOHN W. HOLLOWAY, *Secretary*

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## CLINICAL CONGRESS TO BE HELD IN CLEVELAND DECEMBER 16 TO 20

THE thirty-second Clinical Congress of the American College of Surgeons, originally planned for New York from September 9 to 13 but postponed because of overlapping with the United Nations Assembly which will overtax hotel facilities, has now been scheduled for Cleveland, Ohio, from December 16 to 20. The change in place was necessary because suitable accommodations were not available in New York during the remainder of this year.

Cleveland has in its Public Auditorium superb facilities for the holding of most of the sessions and for the technical and educational exhibits. Certain official meetings, some of the panel discussions, and a few conferences, will be held in the Cleveland and Statler hotels where excellent accommodations are available. A clinical program in the Cleveland hospitals and Western Reserve University School of Medicine is also being developed by the Committee on Arrangements of which Dr. Thomas E. Jones is Chairman and Dr. John W. Holloway is Secretary.

This will be the first time that Cleveland has been host city to the Clinical Congress. A meeting was planned there in 1942 after the United States Army took over the Stevens Hotel in Chicago where the Congress had originally been scheduled. Later there was an announcement that the Cleveland Public Auditorium would also be needed by the War Department, and the 1942 Clinical Congress was voluntarily cancelled because of this and other war conditions.

Cleveland convention and hotel officials express great interest in the Clinical Congress as a contribution to the city's educational and scientific advancement. The Fellows are assured of a most congenial atmosphere in which to meet. The

American College of Surgeons is well known and highly esteemed in Cleveland, as is natural in the home city of one of its most eminent founders, the late George Crile, Chairman of the Board of Regents for several years, and of many other honored Fellows, who have labored to develop the medical school and hospitals into maximum effectiveness in service to the sick and injured.

Cleveland has twenty-one hospitals approved by the American College of Surgeons. In several of these, operative and nonoperative clinics and demonstrations will be arranged during the week of the Congress. The preliminary clinical program will be published in a later issue.

As for the program that had been planned for New York for the scientific sessions, hospital conferences, and other events except clinics, this will be carried out in Cleveland with few, if any, changes. Up to the time of going to press there has not been opportunity to receive replies from all of the speakers who have been asked whether the change of time and place will affect their acceptance, but most responses have been in the affirmative, indicating that the program as outlined in succeeding pages will stand.

There is keen appreciation of the work done by the New York committee in preparing the clinical program there. While it cannot be used this year, it is hoped that it can be carried out at the 1947 Clinical Congress in New York.

### FIRST POSTWAR CONGRESS

Following the same plan developed for the New York meeting, this first postwar Clinical Congress will differ from the meetings for several years prior to the war in that a return will be made to the original custom of holding the Presidential Meet-



ing on the opening evening, Monday, and the Convocation on the final evening, Friday, instead of combining them on the first night. This separation is especially desirable this year since exceptional interest will be centered on the Convocation as a result of the participation in the ceremonies of classes from 1942 through 1946.

#### PRESIDENTIAL MEETING

The Presidential Meeting will be held on Monday evening in the Music Hall of the Cleveland Public Auditorium. It will begin with the impressive processional of the officers, regents, and honorary guests. Dr. Thomas E. Jones, Chairman of the Committee on Arrangements, will give the address of welcome. Dr. W. Edward Gallie of Toronto, President of the College, will preside and will deliver the Presidential Address. An inaugural ceremony will be held for the incoming officers: Dr. Irvin Abell of Louisville, President; Dr. Leland S. McKittrick of Boston, First Vice-President; and Dr. F. Phinizy Calhoun, Atlanta, Second Vice-President. Foreign guests will then be introduced.

The first Martin Memorial Lecture will be a new feature to be included in the Presidential Meeting this year. The invitation to give this lecture has been accepted by Dr. Edward D. Churchill of Boston. This lectureship was established upon motion of the Board of Regents at its mid-year meeting on April 1, as a memorial to both Dr. Franklin H. Martin and Mrs. Martin. The founder of the College and of SURGERY, GYNECOLOGY AND OBSTETRICS was joined by his wife in making the College the beneficiary at their deaths of the Journal, together with its physical plant operated by the Surgical Publishing Company of Chicago, of which they were the owners. Doctor Martin died in 1935 and Mrs. Martin in 1945.

The Martin Memorial Lecture, to be given annually during the Clinical Congress, and dealing with a scientific subject of the author's choosing, will supplant the Annual Oration in Surgery.

#### CONVOCATION

The Convocation scheduled for Friday evening, will open with a processional of officers, regents, and governors. The President, Dr. Irvin Abell, will preside and will make the opening remarks, confer the honorary fellowships, and present the candidates for fellowship.

An Assembly of Initiates will be held prior to the Convocation on Friday in order to instruct them in the Convocation procedure and other matters. On this occasion the initiates will sign the fellowship roll.

Several hundred surgeons who have been received into fellowship *in absentia* during the years in which no Convocation was held, will be added to the number of initiates for the current year who will be present to participate in the initiation ceremonies.

#### SCIENTIFIC SESSIONS

##### General Surgery

Eminent surgeons and specialists, recognized as authorities in their fields, will address the scientific sessions, to be held on Tuesday, Wednesday, and Thursday evenings. These will be conducted as symposia, and the subjects for the three nights will be as follows: Tuesday, "Care of the Patient Before and After Operation"; Wednesday, "Venous Thrombosis and Prevention of Pulmonary Embolism"; and Thursday, "Antibiotic and Chemotherapeutic Agents in Surgery." The annual Fracture Oration will be included in the Wednesday evening program.

Two major panel discussions will be held every afternoon except Thursday when the first panel will be omitted because of the annual meeting of the Fellows.

A symposium on fractures and other traumas will be held on Tuesday afternoon, and a symposium on cancer on Wednesday, from 2:00 to 4:00 o'clock.

Concurrent panel discussions are also planned on Friday afternoon for each of the following specialties: plastic surgery, thoracic surgery, urology, neurological surgery, orthopedics, and obstetrics. Outlines of the programs are published in succeeding pages.

##### Ophthalmology and Otorhinolaryngology

Ophthalmology panel discussions will be held Tuesday, Wednesday, and Thursday mornings at 11:00 o'clock on, respectively, "Retinal Detachment," "Glaucoma," and "Keraplasty." On Tuesday evening at 8:00 o'clock there will be a symposium on "Orbital Reconstruction Including Prosthesis." On Thursday evening a scientific session is planned with the following as the subjects: "Recent Advances in Ophthalmology"; "Medical Treatment of Glaucoma"; and "Visual Disturbances Associated with Head Injuries."

Otorhinolaryngology panel discussions will be held Tuesday, Wednesday, and Thursday mornings at 11:00 o'clock on, respectively, "Treatment of Ménière's Disease," "Osteomyelitis of the Skull," and "Rehabilitation of War Deafness." On Tuesday evening at 8:00 o'clock there will be a symposium on "Treatment of Deafness" and on Thursday evening a symposium on "Surgery of the Nasal Accessory Sinuses."

Of interest to ophthalmologists, otorhinolaryngologists, and other surgeons will be a symposium to be held on Wednesday evening at 8:00 o'clock on "Plastic Surgery of the Head and Neck."

#### FORUMS ON FUNDAMENTAL SURGICAL PROBLEMS

The Forums on Fundamental Surgical Problems will be conducted on Tuesday, Wednesday, Thursday, and Friday mornings. Included in them will be brief reports of original clinical and experimental observations relating to the broad aspects of surgery and the surgical specialties. No prepared discussions of the reports are planned, but questions and comments will be invited. Especially keen interest is expected in these sessions this year because of the accumulation of the results of 5 years of work since the last Clinical Congress. Dr. Owen H. Wangensteen of Minneapolis, chairman of the committee which is planning the program, is working toward representation of as many as possible of the various university departments of surgery in this presentation of clinical and experimental research work.

The enlistment of the interest of young men who are doing original work, through the forums, is one of the most beneficial results of these sessions which are now considered to be an indispensable feature of every Clinical Congress.

#### HOSPITAL CONFERENCE

Dr. W. Edward Gallie, President of the College, will address the opening session of the twenty-fifth annual Hospital Standardization Conference on Monday morning at 10:00 o'clock in the Auditorium; and will preside at the meeting, which will be attended by surgeons and hospital representatives. Following Dr. Gallie's résumé of the Hospital Standardization program of the College, including plans for the future, there will be reports on the progress of the 1946 Hospital Standardization survey, final results of which, including the Approved Lists of hospitals, cancer clinics, and approved hospitals for graduate training in surgery, will be announced at the end of the year, instead of at the Clinical Congress as was the practice in former years.

The remainder of the Monday morning session will be devoted to talks by medical and hospital authorities on advances in medicine and surgery as they affect the postwar hospital, with particular consideration of their relation to the Hospital Standardization program.

The afternoon conference on Monday will be concentrated upon current problems and the outlook for the future in nursing service. The Tuesday morning conference will have as its main sub-

ject personnel management, and the Tuesday afternoon session will be centered around personnel problems in specific fields, such as dietary, laboratory, medical records, medical social service, x-ray, physical and occupational therapy, and other professional and semi-professional services. The discussions will emphasize the importance of scientific management techniques in assuring high quality service from personnel.

The Wednesday morning conference will have as its main theme the importance of assuring high standards of care to the community and patients through providing in the general hospital facilities for all types of illness. The subject will be discussed from the standpoint of psychiatric, tuberculous, cancer, chronically ill, and convalescent patients. The Wednesday afternoon conference will center mainly around discussion of ways of improving co-operation between general hospitals and special hospitals in the care of all types of special patients.

The Thursday morning conference will revolve around the physical plant of the hospital and the importance of improvement and modernization in raising standards of care of the patient. New mechanical and technical developments will be presented. The afternoon conference will discuss the hospital as the health center of the community, with consideration of the effects of this concept upon hospital public relations and upon the progress of preventive medicine and public health.

An evening conference will be held at 7:30 o'clock on Tuesday. This will be devoted to discussion of the responsibilities of trustees, and members of governing boards will be especially invited to attend and to participate. A conference will be held on Wednesday evening also. This will be a round table conference on responsibilities of hospital administrators, and the preparation which is necessary to enable them to cope successfully with the wide range of administrative problems. The discussion of these problems will interest all hospital personnel.

#### ANNUAL MEETING OF FELLOWS

The annual meeting of the Governors and Fellows will be held on Thursday afternoon at 1:45. There will be election of officers and governors. The annual meeting affords the Fellows of the College an opportunity to hear reports of officials on the work of the organization, and to learn how it has not only raised the professional and ethical standards of surgery, but has also promoted good hospitalization and general improvement in the practice of medicine in the United States and Canada. Each Fellow has a

personal part in this work and may extend the influence of the College materially in his local community. Hospital Standardization alone offers him unlimited opportunity to provide better medical care for his patients in the hospital in which he works through continuous progress in applying the principles of the Minimum Standard which insure the best care of the patient.

Every Fellow will want to attend this important meeting, at which reports will be presented on financial affairs; Hospital Standardization; Graduate Training in Surgery; Medical Motion Pictures; Publications; Public Relations. Library and Literary Research; the work of the state and provincial credentials committees, committees on applicants, and the Committee on History Reviews; Sectional Meetings, 1946; and the Department of Clinical Research, including cancer clinics, Medical Service in Industry, the Committee on Cancer, and the Committee on Fractures and other Traumas. Dr. Abell will report on administration of the College, staff changes, and retirements, and Dr. Arthur W. Allen, Vice-Chairman of the Board of Regents will discuss "Fellowships, Obligations and Opportunities."

#### STATE AND PROVINCIAL EXECUTIVE, CREDENTIALS AND JUDICIARY COMMITTEES

On Wednesday morning from 9:00 to 12:00 o'clock the State and Provincial Executive, Credentials, and Judiciary committees will meet to discuss their respective activities.

#### MEDICAL MOTION PICTURES

The latest available films showing surgical procedures and related subjects will be shown in the medical motion picture exhibits which will be held daily. These are a much appreciated feature of the Clinical Congress. Despite the decrease in production of such films during the war period, a surprising number of new pictures on varied subjects are being received by the American College of Surgeons for review.

The schedule will be so arranged as not to conflict with either the clinical program at the hospitals or the scientific sessions. Both sound and silent, standard and color films will be shown, all of which have been approved by the Committee on Medical Motion Pictures.

#### TECHNICAL AND SCIENTIFIC EXHIBITION

The technical exhibit, together with the registration and clinic ticket bureaus, will be held in the Cleveland Public Auditorium. Leading manufacturers of surgical instruments, x-ray apparatus,

sterilizers, operating room lights, ligatures, dressings, hospital apparatus and supplies of all kinds, pharmaceuticals, and publishers of medical books will be represented in the exhibition. The technical exhibits will demonstrate many of the newer features learned from our experience in the war.

#### ADVANCE REGISTRATION

The hospitals of Cleveland afford accommodations for a considerable number of visiting surgeons. However, in order to insure against overcrowding, attendance at the Congress will be limited to the number that can be comfortably accommodated at the meetings and also by accommodations in the hotels. It is therefore expected that surgeons who wish to attend the Congress will register in advance.

Fellows of the College whose dues are paid to December 31, 1945, initiates of the classes of 1947, through 1946, and Fellows in military service will not be required to pay a registration fee for the Clinical Congress in Cleveland. Checks that have already been sent for the New York Congress are being returned. For endorsed junior candidates the fee is \$5.00. Surgeons, not Fellows, who attend as invited guests of the College, will pay a registration fee of \$10.00.

#### CLEVELAND HOTELS AND THEIR RATES

Although the hotel situation in Cleveland seems more favorable than in many other cities, it is nevertheless essential to make reservations as far in advance as possible. Following is a list of the principal hotels:

	No. of Rooms	Rates
The Alcazar, Surrey and Derbyshire Roads	200	\$3.00 up
Hotel Allerton, E. 13th St. & Chester Ave.	600	2.65 up
Hotel Auditorium, E. 6th & St. Clair Ave.	300	2.00 up
Belmont Hotel, Euclid Ave. at E. 40th St.	200	2.00 up
Hotel Bolton Square, Carnegie at E. 89th St.	300	1.50 up
Carter Hotel, 1012 Prospect Ave.	600	4.00 up
Hotel Cleveland, Public Sq. & Superior Ave.	1,000	3.00 up
Fenway Hall Hotel, Euclid Ave. at Univ. Circle	400	3.00 up
The Hollenden, Superior Ave. at E. 6th St.	1,000	3.00 up
Lake Shore Hotel, 12506 Edgewater Dr.	450	3.50 up
New Amsterdam Hotel, Euclid Ave. at E. 22nd St.	300	2.00 up
Hotel Olmsted, E. 9th St. & Superior Ave.	250	3.00 up
Park Lane Villa, E. 105th & Park Lane Ave.	400	3.00 up
Sovereign Hotel, 1575 E. Blvd.	300	2.50 up
Hotel Statler, Euclid Ave. at E. 12th St.	1,000	3.00 up
Tudor Arms Hotel, Carnegie at E. 107th St.	200	3.50 up
Wade Park Manor, E. 107th & Park Lane	400	3.50 up
The Westlake, Blount St., Rocky River.	400	3.00 up

## CLINICAL CONGRESS PROGRAM IN BRIEF

*Monday*

- 10:00 General Assembly for Surgeons and Hospital Representatives  
 1:30-3:00 Panel Discussion  
 2:00 Clinics, Demonstrations and Clinical Group Conferences, Selected local hospitals  
 2:00 Hospital Conference  
 1:00 Surgical Film Exhibition (General)  
 3:30-5:00 Panel Discussion  
 8:00 Presidential Meeting

*Tuesday*

- 9:00 Clinics, Demonstrations and Clinical Group Conferences, Selected local hospitals  
 10:00 Hospital Conference  
 9:30 Surgical Film Exhibition (Eye, Ear, Nose and Throat)  
 9:30-12:00 Forum on Fundamental Surgical Problems, 10:00 Surgical Film Exhibition (General)  
 11:00 Panel Discussions  
     Ophthalmology  
     Otorhinolaryngology  
 1:30-3:00 Panel Discussion  
 2:00 Clinics, Demonstrations and Clinical Group Conferences, Selected local hospitals  
 2:00 Hospital Conference  
 2:00 Symposium on Fractures and Other Traumas  
 2:00 Surgical Film Exhibition (General)  
 3:30-5:00 Panel Discussion  
 7:00 Surgical Film Exhibition (Eye, Ear, Nose and Throat)  
 7:30 Hospital Conference—Trustees  
 8:00 Scientific Session, General Surgery  
 8:00 Scientific Session, Ophthalmology  
 8:00 Scientific Session, Otorhinolaryngology

*Wednesday*

- 8:00 Meeting of Cancer Committee  
 9:00 Clinics, Demonstrations and Clinical Group Conferences, Selected Local Hospitals  
 9:30 Hospital Conference  
 9:30 Surgical Film Exhibition (Eye, Ear, Nose and Throat)  
 9:30-12:00 Forum on Fundamental Surgical Problems, 10:00 Surgical Film Exhibition (General)  
     State and Provincial Committees:  
     9:30 Judiciary Committees  
     10:00 Executive Committees  
     10:30 Credentials Committees and Committees on Applicants  
 11:00 Panel Discussions  
     Ophthalmology  
     Otorhinolaryngology  
 12:00 Meeting of Board of Governors  
 1:30-3:00 Panel Discussion  
 2:00 Clinics, Demonstrations and Clinical Group Conferences, Selected local hospitals  
 2:00 Symposium on Cancer

- 2:00 Surgical Film Exhibition (General)  
 2:30 Hospital Conference  
 3:30-5:00 Panel Discussion  
 6:00 Vandyck Reunion Dinner  
 7:00 Surgical Film Exhibition (Eye, Ear, Nose and Throat)  
 7:30 Hospital Conference  
 8:00 Scientific Session, General Surgery  
 8:00 Scientific Session (Eye, Ear, Nose and Throat)

*Thursday*

- 9:00 Clinics, Demonstrations and Clinical Group Conferences, Selected local hospitals  
 9:30 Hospital Conference  
 9:30 Surgical Film Exhibition (Eye, Ear, Nose and Throat)  
 9:30-12:00 Forum on Fundamental Surgical Problems  
 10:00 Surgical Film Exhibition (General)  
 11:00 Panel Discussions  
     Ophthalmology  
     Otorhinolaryngology  
 1:30 Adjourned Meeting, Governors  
 1:45 Annual Meeting, Fellows  
 2:00 Clinics, Demonstrations and Clinical Group Conferences, Selected local hospitals  
 2:00 Hospital Conference  
 3:00 Panel Discussion—Graduate Training in Surgery,  
 3:30-5:00 Panel Discussion  
 3:30 Surgical Film Exhibition (General)  
 3:30 National and Regional Fracture Committees,  
 4:00 Committee on the Library  
 7:00 Surgical Film Exhibition (Eye, Ear, Nose and Throat)  
 8:00 Scientific Session, General Surgery  
 8:00 Scientific Session, Ophthalmology  
 8:00 Scientific Session, Otorhinolaryngology,

*Friday*

- 9:00 Clinics, Demonstrations and Clinical Group Conferences, Selected local hospitals  
 9:30 Surgical Film Exhibition (Eye, Ear, Nose and Throat)  
 9:30-12:00 Forum on Fundamental Surgical Problems  
 10:00 Surgical Film Exhibition (General)  
 1:30-3:00 Panel Discussion, Surgery of the Stomach  
 2:00 Clinics, Demonstrations and Clinical Group Conferences, Selected local hospitals  
 2:00-4:00 Panel Discussions  
     Obstetrics  
     Plastic Surgery  
     Neurological Surgery  
     Thoracic Surgery  
     Urology  
     Orthopedic Surgery  
 2:00 Surgical Film Exhibition (General)  
 3:30-5:00 Panel Discussion, Surgery of the Vascular System.  
 8:00 Convocation

## EVENING SCIENTIFIC SESSIONS

## GENERAL SURGERY

## Tuesday

*Care of the Patient before and after Operation*

Fluid and Electrolyte Balance. CARL MOYER, Eloise, Michigan.

Nutritional Preparation of the Substandard Risk Patient. RICHARD L. VARCO, Minneapolis.

Use of Blood and Blood Substitutes. JOHN D. STEWART, Buffalo.

Blood Transfusion Problems, with Special Reference to the Rh Factor. ALEXANDER S. WIENER, Brooklyn.

Safe Conduct of the Patient Through Operation. OWEN H. WANGENSTEEN, Minneapolis.

## Wednesday

*Venous Thrombosis and Prevention of Pulmonary Embolism*

Interruption of Deep Veins. ARTHUR W. ALLEN, Boston.

Sympathetic Nerve Block. ALTON OCHSNER, New Orleans.

Anticoagulants. D. W. GORDON MURRAY, Toronto.

*Fracture Oration*

Modern Methods in the Treatment of Fractures. EDWIN W. RYERSON, Chicago.

## Thursday

*Antibiotic and Chemotherapeutic Agents in Surgery*

Pathologic Physiology of Surgical Infections. JOHN S. LOCKWOOD, New Haven.

Penicillin—Its Use in Surgery and Influence on Earlier Types of Chemotherapy. WILLIAM A. ALTEMEIER, Cincinnati.

Streptomycin. HORTON C. HINSHAW, Rochester.

Correlation of the Use of Antibiotic and Chemotherapeutic Agents with General Principles of Surgery.

CHAMP LYONS, New Orleans.

## OPHTHALMOLOGY

## Tuesday

*Orbital Reconstruction Including Prosthesis*

Acrylic Prosthesis. A. D. RUEDEMANN, Cleveland.

Basket Implant. NORMAN L. CUTLER, Wilmington.

Orbital Measurements.

Reconstruction of Upper Lid and Orbital Floor Defects. Major ARTHUR E. SHERMAN, Springfield Missouri.

## Thursday

Surgical Applied Anatomy in Eye Surgery. MEYER WIENER, Coronado.

Visual Disturbances Associated with Head Injuries. JOHN MCGAVIC, Fort Madison.

## OTORHINOLARYNGOLOGY

## Tuesday

*Treatment of Deafness*

The Suppurating Ear.

The Fenestration Operation. GEORGE E. SHAMBAUGH, JR., Chicago

Use of Radium for Conductive Deafness. JOHN E. BORDLEY, Baltimore.

## Thursday

*Surgery of the Nasal Accessory Sinuses*

Indications for Surgery in the Light of the Use of Antibiotics.

Intranasal Surgery. JOHN J. SHEA, Memphis.

External Operations.

## SYMPOSIUM ON PLASTIC SURGERY OF THE HEAD AND NECK

*Wednesday 8 p.m.*

Cancellous Bone Grafts to the Jaw.

Repair of Nasal Defects with Free Composite Grafts of Skin and Cartilage from the Ear. JAMES B. BROWN, St. Louis.

Studies in the Anatomy and the Repair of Cleft Palate.

Preservation of Function Following Resections of Jaw Tumors.

## PANEL DISCUSSIONS

## GENERAL SURGERY

*Monday, 1:30-3:00 p.m.*

Rehabilitation of the Surgical Patient and Early Ambulation. Leader, HOWARD RUSK, New York.

*Monday, 3:30-5:00 p.m.*

The Treatment of Cancer of the Large Bowel. Leader, FREDERICK A. COLLIER, Ann Arbor.

*Tuesday, 1:30-3:00 p.m.*

Thiouracil in Thyroid Disease. Leader, FRANK LAHEY, Boston.

*Tuesday, 3:30-5:00 p.m.*

Recent Trends in the Management of Carcinoma of the Cervix. Leader, JOE VINCENT MEIGS, Boston.

*Wednesday, 1:30-3:00 p.m.*

Anesthesia. Leader, HENRY K. BEECHER, Boston.

*Wednesday, 3:30-5:00 p.m.*

Protein Metabolism in the Surgical Patient. Leader, ROBERT ELMAN, St. Louis.

*Thursday, 3:30-5:00 p.m.*

Spinal Cord Injuries. Leader, HOWARD C. NAFFZIGER, San Francisco.

*Friday, 1:30-3:00 p.m.*

Surgery of the Stomach. Leader, ROSCOE R. GRAHAM, Toronto.

*Friday, 3:30-5:00 p.m.*

Surgery of the Vascular System. Leader, DANIEL C. ELKIN, Atlanta, Georgia.

## SURGICAL SPECIALTIES

*Friday 2:00-5:00*

Orthopedic Surgery Panel. (Subject to be announced.) Leader, CARL E. BADGLEY, Ann Arbor.

Urology Panel. (Subject to be announced.) Leader, HERMAN L. KRETSCHMER, Chicago.

Plastic Surgery Panel. (Subject to be announced.) Leader, ROBERT H. IVY, Philadelphia.

Neurological Surgery Panel. (Subject to be announced.) Leader, FRANCIS C. GRANT, Philadelphia.

Obstetrics Panel. (Subject to be announced.) Leader, FREDERICK C. IRVING, Boston.

Thoracic Surgery Panel. (Subject to be announced.) Leader, RICHARD H. SWEET, Boston.

## OPHTHALMOLOGY

Panel discussions in the field of Ophthalmology are planned for Tuesday, Wednesday, and Thursday mornings at 11:00 o'clock, on the following subjects: Retinal Detachment; Glaucoma; Keratoplasty.

## OTORHINOLARYNGOLOGY

Panel discussions on subjects in the field of Otorhinolaryngology are planned for Tuesday, Wednesday and Thursday mornings at 11:00 o'clock on the following subjects, respectively: The Treatment of Ménière's Disease; Osteomyelitis of the Skull; Rehabilitation of War Deafness.

## SYMPOSIUM ON FRACTURES AND OTHER TRAUMAS

**A**T 2:00 o'clock on Tuesday afternoon there will be held a symposium on Fractures and Other Traumas under the direction of Robert H. Kennedy of New York. This symposium will be devoted to a number of brief presentations by specialists in various fields concerning new or improved methods adopted during the war which are applicable to injury in civilian surgery. The aim is to give a rapid survey of worthwhile gains made during the war which may prove of lasting value in the field of trauma.

Among the fifteen or twenty short papers which are planned are the following:

Bone Grafts. GEORGE K. CARPENTER, Nashville.

Spinal Cord Injuries. DAVID H. POER, Atlanta.

Injuries to the Rectum. EDMUND J. CROCE, Worcester.

Transportation of Fractures. WILLIAM J. STEWART, Columbia.

Replacement of Skin Defects. JAMES B. BROWN, St. Louis.

Fractures of the Carpal Scaphoid. MATTHEW CLEVELAND, New York.

Amputations. RUFUS H. ALDREDGE, New Orleans.

Training of Amputees. HENRY H. KESSLER, Newark.

Rehabilitation. Col. A. WILLIAM REGGIO, Washington.

Compound Fractures Treated with Penicillin and Delayed Primary Closure. OSCAR P. HAMPTON, Jr., St. Louis.

## SYMPOSIUM ON CANCER

A symposium on cancer is planned for Wednesday afternoon. The Cancer Committee of the College has done outstanding work in furthering the development of cancer clinics in hospitals and providing for the registration of cured cases of malignant disease in the cancer archives. The chairman of this com-

mittee will give a brief review of these activities of the College in opening the symposium.

Other subjects of practical interest are under consideration for inclusion in the program, which is being planned to interest surgeons, pathologists, and radiologists.

September, 1946

**SURGERY**  
**GYNECOLOGY AND OBSTETRICS**  
*Supplement*

**INTERNATIONAL ABSTRACTS**  
**OF SURGERY**

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# INTERNATIONAL ABSTRACTS OF SURGERY

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## COLLECTIVE REVIEW

### SPLENECTOMY, WITH SPECIAL REFERENCE TO ITS HISTORICAL BACKGROUND

#### The Indications and Rationale, and a Comparison of Reported Mortality

H. L. PUGH, Captain, (M.C.), U.S.N.

AS IS nearly always true of any situation wherein a mystery exists, a special interest attaches to that situation because of the mystery. This has for long been the case with reference to the spleen and in this instance the mystery is all the more fascinating because of the multiplicity of its elements which include (1) the functions of the spleen; (2) the role played by the spleen as a cause of certain systemic diseases; (3) the effect upon the spleen of diseases not primarily splenic; and (4), finally, the mystery as to the rationale of surgery in certain instances—and it may as well be said in the beginning that practically the only surgery applicable to the spleen is splenectomy. However, regardless of whatever the degree of appeal a discussion of the spleen and splenectomy may hold because of the mystery which persists in surrounding that organ, a justification for the publication of this article is sought upon entirely independent grounds, namely: (a) to present a brief review of the literature and compare the concepts voiced during the last half of the last century with those prevalent at the beginning and, finally, with those of the middle of the present century; (b) to refresh the mind of the surgeon with respect to knowledge he should possess relative to the alleged functions of the

spleen, the indications for splenectomy, and the results which may be contemplated, in order that he may render a comprehensive expression of opinion and make well advised recommendations when called in consultation; (c) to point out certain operative technicalities deemed worthy of consideration; (d) to consider the mortality rate from splenectomy, past and present; and (e) to report a series of 15 splenectomies.

#### HISTORICAL

There appears to be considerable confusion in the literature as to when the first successful splenectomy was performed. Legend has it that the marathon runners in the last century B. C. used to have their spleens removed "to improve their wind." The "Talmud" (200-600 A. D.), according to Macht (44), contains references which indicate that not only were runners deprived of their spleen in order to increase their efficiency, but that spleens were also removed from horses as a means of augmenting their speed. Similar reference is found in the "Natural History of Pliny," from 23 to 79 A. D. and in the Arabic literature, according to this author. Macht (45), moreover, in a series of experiments on rats, was able to demonstrate an apparent improvement in the running speed of splenectomized animals. Krumbhaar (46) in his edition of Castiglioni's "History of Medicine" (page 551) makes reference to an experimental splenectomy performed by Guiseppe Zambaccari of Florence in the 17th

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century, and on page 720 of the same book, reference is made to Gustav Simon's (1824-1876) having (in 1857) reintroduced the "forgotten operation of splenectomy." Again from page 840, the following sentence is copied: "Splenectomy, which began centuries earlier with Zaccarelli (1549) and Zambaccari (1680), was revived in the modern period by Kuechler in 1855 and Spencer Wells in 1866." However, the first published operation on the spleen is said, by Alessandri, to have been that by Viard in the 16th century. The vessels were ligated and the spleen was left in.

In 1856 Adelmann of Berlin collated 15 splenectomies. Beyond the statement that the operation was done for various diseases and injuries, no specific indication is given in the reference by Russell. In 1880, Russell, in a treatise upon the management of splenic injuries associated with malarial spleen, devoted several pages to an expostulation upon the indication and justification for operative intervention in case of trauma to the spleen, but no forthright mention was made of a single splenectomy having been done in his series of 39 cases, 28 of which terminated fatally and, as a matter of fact, the diagnosis in the remainder was apparently only presumptive.

Fowler states that the first splenectomy for cyst was performed in 1880 by the French surgeon Pean. Heineck credits the first splenectomy to Roddick in 1885. The spleen in this instance is said to have been removed through a small opening in the lumbar region. The reference fails to indicate for what condition this operation was performed. If for a condition other than rupture, it need not necessarily be in conflict with the statement by Bier *et al.* that the first splenectomy for rupture was performed in 1892. Albeit, it does seem unlikely that the series of 37 splenectomies for ruptured spleen reported in 1900 by Bessel-Hagen (13) should all have been done after 1892.

In any event, that the spleen is not essential to the human economy has been known for a long time. Bardeleben, over 100 years ago, demonstrated conclusively that its removal from healthy animals could be accomplished without deleterious effect. According to the answers to examination questions for admission to the Medical Corps of the Navy which the author has had occasion to read, there seems to be a popular belief in some quarters that certain animals, notably the zebra and giraffe, may be minus a spleen by reason of failure of development. Owen in his work on anatomy of the vertebrates described the spleen in all manner of animals from the ornithorhynchus to the giraffe and elephant and makes no mention of its being absent in any species of animal.

The list of conditions for which splenectomy has been advocated has changed to an appreciable degree with the passage of time. Some of the conditions which were formerly regarded as indications have been dropped from the list, while others have been added as our knowledge with respect to the physiology of the spleen and its relationship to certain diseases has increased. It is now well recognized that in the light of modern surgery, splenectomy is imperative under certain conditions, distinctly indicated in others, and probably indicated in others. It must be admitted, nevertheless, that most of our modern knowledge with respect to the spleen and splenectomy has been arrived at by accident, or the trial and error route.

In a very comprehensive paper on splenectomy by George Ben Johnston, published in 1908, 15 indications for splenectomy were listed. Six of these indications, however, are contained in a tabulation of idiopathic and malarial hypertrophy without or with complications such as ectopy and/or twisted pedicle. In 1928 Edwin Beer listed which splenectomy had been done but stated that the results had been so unsatisfactory as to lead to the abandonment of this procedure. In a series of 153 splenectomies for pernicious anemia collected after 2 years, and both of whom still suffered from pernicious anemia.

It is interesting to note that one quarter of a century ago Beer's concepts relative to the indications for splenectomy were practically the same as those expressed by the present day commentators on the subject. Devine, in his textbook, Whipple (68) reported 1,457 patients with splenic lesions seen over an 18 year period by the combined splenic clinic of the Columbia Medical Center. These cases were separated into 20 splenectomy indicated, as only 174 splenectomies were done in the whole reported series. In 1941, Hayden classified the indications for splenectomy, listing the several conditions in order of their urgency or advisability, and gave lastly a list of conditions for which splenectomy is sometimes done but is contraindicated. In 1943, Pernokis published an excellent discussion on the three principal medical or hematopoietic dyscrasias for which splenectomy is indicated.

In the military service the most common indication for splenectomy is rupture of the spleen. This was true particularly during the war and was incident not only to combat casualties but to the

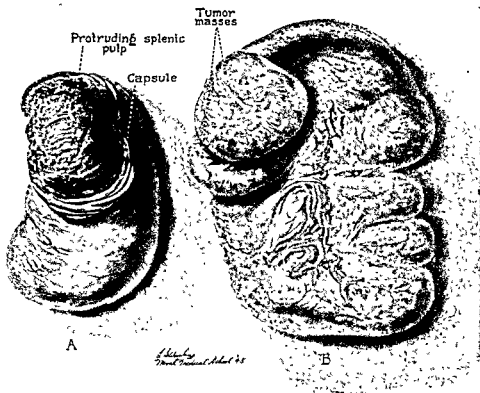


Fig. 1. A. Delayed rupture of spleen. Trauma, blow from thrown baseball 3 weeks previously. B. Hodgkin's disease. This case had been erroneously diagnosed preoperatively as Banti's disease.

increased tempo of activity in general, and to vigorous physical activity in camps, training stations, and Navy Yards. In the Navy 69 splenectomies for noncombat rupture were reported during the years from 1942 to 1944, inclusive. Another factor which may be alleged to have contributed to the rupture of spleens among the Naval and Marine Corps personnel during the early part of the late war was that of malaria. Malarial spleens may rupture spontaneously although this is a rare occurrence (Kellner *et al.*). In any event, a malarial spleen is more prone to rupture when subjected to violence than a normal spleen.

## FUNCTIONS

Numerous functions have been ascribed to the spleen, some fanciful and some factual. However, since it is with respect to its physiology that some of the interesting elements of its enigma prevail, it would appear desirable to review at this point the several functions which have at one time or another been claimed for the spleen. Some writers more or less dogmatically enumerate the functions of the spleen, while others express considerable reservation in their estimate of its physiology. Actually there appears to be little more irrefutable proof of the functions of the spleen today than existed 50 years ago.

The spleen is generally accepted to be a part of the reticuloendothelial system, of which the liver, the medullary tissue of the bone, the lymphatic glands, and the cortex of the adrenals are the other constituent additional organs or tissues. This view is based largely upon the existence of a type of cell common to the several named structures. It is believed that following splenectomy the spleen's function is taken over by the remaining organs of the reticuloendothelial system. From Hippocrates, who admitted a lack of knowledge about the spleen, and Galen, who hazarded the guess that it had something to do with the purification of the blood, down to the present, the veil of mystery has only partially been lifted by our modern advances in physiology. Nevertheless, there is one anatomical feature which above all other considerations bespeaks the fact that the spleen performs an extremely energetic function, whether that function be essential or nonessential, and that is its vascular system, both afferent and efferent, of inordinate capacity. Aschoff and Landau point out that the well oxygenated arterial blood delivered to the spleen indicates that some substance is being oxidized but that deoxygenation of the blood in itself is not believed to be a splenic function. It is concluded that the oxygen is used in the

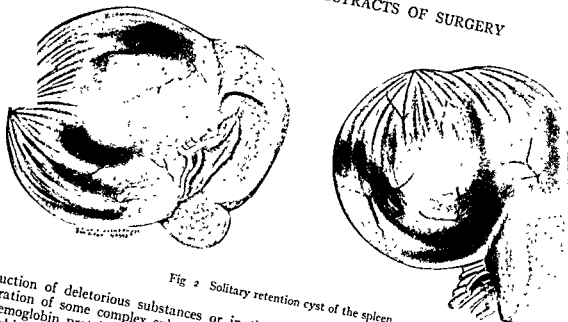


Fig 2 Solitary retention cyst of the spleen.

destruction of deleterious substances or in the elaboration of some complex substance such as the hemoglobin protein molecule. Of the functions which have been more commonly ascribed to the spleen, the following may be reviewed:

1. That of a hematopoietic organ in prenatal life and perhaps during infancy and a "burial ground" for disintegrated and worn out red blood corpuscles, beginning probably in childhood and continuing on through adult life. The destruction of red corpuscles results in the liberation of hemoglobin. This is said by some to be conveyed through the splenic vein to the liver where it is converted into bilirubin. Pernokis points out that many investigators have been unable to demonstrate any difference between the intermediary or antecedent elements of bilirubin in the splenic artery and vein and believes with them that the liberated hemoglobin is transformed into bilirubin within the spleen itself.

2. It has for long been taught that the spleen manufactures lymphocytes and monocytes in the lymphoid tissue of its malpighian corpuscles in conjunction with the lymph glands of the body in adult life, and that in the case of certain dyscrasias such as splenomyelogenous leucemia there is an effort on the part of the spleen to revert to its fetal role. Hypertrophy of the organ and the liberation into the circulation of numerous abnormal cells is a natural consequence. Whether these abnormal cells are actually formed in the spleen or whether the influence of a deranged spleen on the bone marrow is responsible for the formation of abnormal cells by the marrow is debatable.

3. The absorption, assimilation, and storage of iron liberated from the decomposition of red blood cells is a role ascribed to the spleen. This iron is combined with hemoglobin and represents from 92 to 98 per cent of the total iron, according to Williams and Wilkins. The remainder of the iron in the body is liver iron and is derived from the feeding and ingestion of iron. Normal blood contains from 45 to 55 milligrams per cent of iron. The total quantity present in the average adult human is about 4 grams. If iron is metabolized by the spleen from hemoglobin obtained or liberated from disintegrating red blood cells, the process must be complete within the spleen since, as it has been observed, there is no difference between the hemoglobin content of the splenic artery and that of the splenic vein.

4. The spleen is said to act as a kind of vascular reservoir for the portal and splanchnic systems. In this capacity it has the property of discharging an additional quantity of blood as needed. Barcroft and Stephens believe that the splenic reservoir is capable of containing about one-fifth of the circulating blood. That the spleen contains a considerable amount of nonstriated muscle tissue, and that it possesses the quality of executing rhythmic contractions comparable to those of the gastrointestinal tract and the uterus, are factors which are consistent with its alleged function as a reservoir. The theory has been advanced that the pain experienced in the left flank upon exercise may be due to the contraction of the spleen in its effort to force pure blood into the general circulation. Since this type of pain is common in long distance runners, it is thought

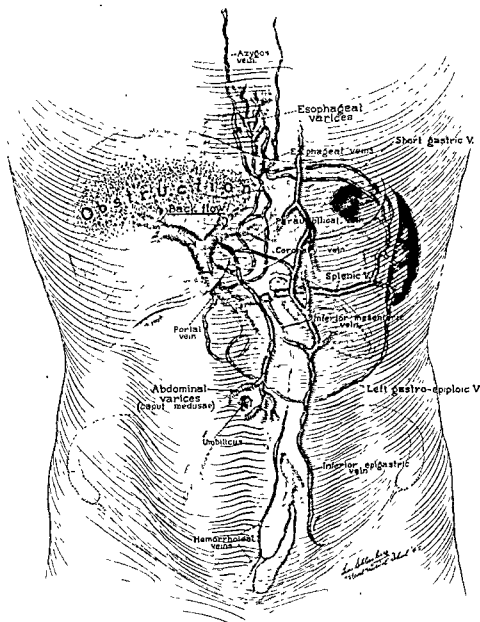


Fig. 3. Schematic illustration of the portal circulation, and its tributaries and connections which constitute the setup for the development of varices on the abdominal wall, esophagus, and rectum as a consequence of obstruction and hypertension in this system.

that it may account for the tradition that the ancients removed the spleen of runners in preparation for the marathon races.

5. To assign to the spleen the function of a blood filter is to credit it with one of its oldest alleged functions. It is in this capacity as a filter that it removes the spheroidal cells which are characteristic of hemolytic jaundice and produces a hypertrophy of the organ and a paucity of circulating red blood cells. When the spleen is removed, these spheroidal cells are free to continue in the circulation and to perform their function just as if they were normal red blood corpuscles.

6. The belief formerly voiced by a number of writers, that blood platelets were produced by the spleen, is no longer tenable in the light of more recent knowledge of hematology. The modern teaching is that blood platelets are manufactured by the red bone marrow because they are the direct descendants of the megakaryocyte which is in turn a descendant of the megakaryoblast, a marrow cell. In thrombocytopenic purpura, the red bone marrow is believed to be inhibited in the manufacture of platelets by a perverted splenic hormonal influence.

7. That the spleen shares in the nitrogenous metabolism is based more on fancy than concrete



Fig. 4. Artist's drawing showing anterior view of splenic pedicle with major vessels and ligamentous attachments of the spleen.

evidence. The proponents of this theory fail to define in what respect and to what extent this is true.

8. The claim has been made that the spleen is a storehouse for various antibodies and is, therefore, instrumental in resisting infection. This is an attractive theory and, while not proved, it is interesting to note that in a series of splenectomized rats injected with pest culture 87 per cent died while only 22 per cent of the controls died (Beer). There seems to be appreciable evidence that bacterial toxins and bacteria introduced into the venous system may be taken up and fixed by the spleen. Granted that malignant metastases to the spleen are rare, there is no very substantial evidence that the spleen possesses an inherent resistance to neoplastic growth.

9. Moynihan (50) accorded the spleen membership in the sympathicoendocrine system.

10. That the spleen elaborates ferments or a hormone which influences the function of the bone marrow appears probable in view of the beneficial results which follow splenectomy in certain cases of Banti's disease and in thrombocytopenic purpura.

#### PATHOLOGY

It would appear appropriate, next, to review the pathological conditions for which splenectomy

is indicated. W. J. Mayo observed that the spleen was much more important pathologically than physiologically. The conditions in which splenectomy is followed by the most gratifying response may be listed as follows:

1. Local disease or injury (neoplasm, cysts, abscess, and rupture)
2. Banti's disease
3. Congenital hemolytic icterus
4. Essential thrombocytopenia

Although splenectomy may be done, and done to advantage, in certain other diseases, such as (a) sickle cell anemia (Hayden), (b) primary splenic neutropenia (Wiseman and Doan), (c) primary splenic panhematopenia (Doan), (d) tuberculosis of the spleen—if there is evidence of what has been referred to by some authors as a "hemming" action on the bone marrow, and (e) certain cases of Gaucher's disease or lipoid reticulo endotheliosis (Hoffman and Makler), certainly the overwhelming majority of indicated splenectomies are done for the conditions listed under the four headings given previously.

*Neoplasm.* Malignancies of the spleen, either primary or secondary, are rare, lymphosarcoma and Hodgkin's disease are listed as the more likely malignant conditions to attack the spleen. In 2 of the splenectomies reported in the present series the latter condition was established as the diag-

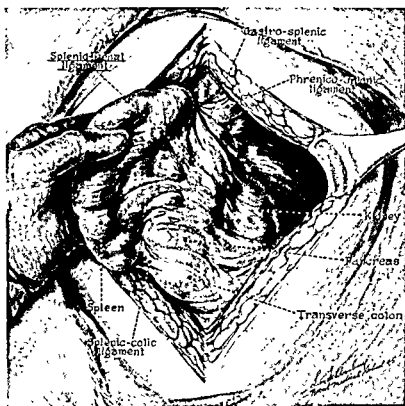


Fig. 5. Artist's drawing showing posterior view of splenic pedicle with ligamentous attachments and anatomic relationship to tail of pancreas and left kidney.

nosis upon histopathological examination of the removed spleen. The spleen of one of these patients is represented by Figure 1B. Primary carcinoma of the spleen appears never to have been established in any case which would bear investigation. Secondary carcinoma is uniformly referred to as being extremely rare (Moynihan (51) and Boyd). When it is considered that lymphatic tissue is so abundantly present in the spleen and this tissue must be constantly exposed to carcinomatous cells which are brought in by the blood stream, it is amazing that it is not as common a site for malignant metastases as is the liver, at least. Whether or not its resistance to malignant growth is due to some immune quality inherently present in the spleen is a matter upon which there has been considerable conjecture but no very convincing conclusions.

**Cysts.** The most common type of cyst of the spleen is the hydatid cyst, but this is found only in countries where hydatid, or echinococcal, disease prevails. True retention cysts of the spleen are very rare in occurrence (only 4 were found in a series of 800 splenectomies at the Mayo Clinic) and are more rarely diagnosed preoperatively. They usually contain serous or serosanguinous fluid. Such a cyst (Fig. 2) constituted the indication for one of the splenectomies herewith

reported and the diagnosis was made preoperatively. Fowler gleaned from the literature up to January, 1939, reports of 137 nonparasitic cysts of the spleen. Of this number 29 per cent were of the large variety with serous content. In 1942, Maclure and Altemeier reported 148 cysts of the spleen as having appeared in the literature up to 1941.

The pathogenesis of splenic cysts is not well understood. Fowler's classification of cysts of the spleen into primary or true, and secondary or false is reasonable in its concept and affords a good working basis. Pepere believes that all serous cysts of the spleen originate from cellular inclusions or inverted vestiges of the serous endothelia.

Acute splenic tumor is an accompaniment of many acute infectious diseases but a well defined abscess of the spleen is rare. When present, incision and drainage are far preferable to splenectomy.

**Trauma.** Rupture of the spleen, whether immediate or delayed, is a leading contender for the right of way as a surgical emergency. The treatment for this condition, it may again be bluntly stated, is splenectomy. Several special diagnostic criteria for ruptured spleen have been enunciated in the literature. Pain in the left shoulder (omalgia), sometimes described as Kehr's

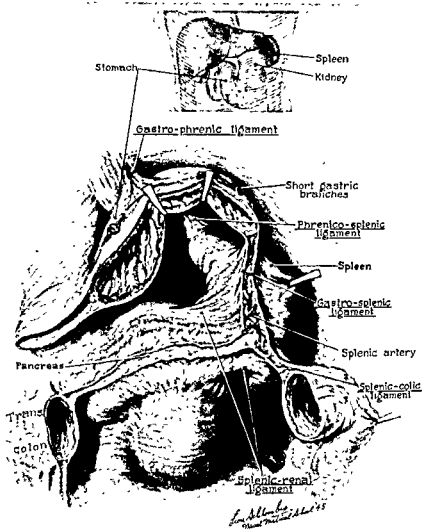


Fig. 6. Artist's drawing indicating anatomic relationships and illustrating the manner in which peritoneal reflections enter into the formation of splenic ligaments. For the sake of artistic clarity, certain of these ligaments have been made to appear much more distinctly defined than they actually are found. The splenicocolic and splenic-renal ligaments are frequently so diaphanous in character as to be scarcely recognizable as ligaments at all.

sign (Armitage), the signs of Pitts and Ballance, or persistent dullness on the left side with shifting dullness on the right side on percussion are mentioned by Heineck as being pathognomonic. A rupture of the spleen should be thought of in all cases in which there is evidence or a history of an intra-abdominal injury. Mazel is quoted by Angle and Kassel as having reported in a review of the literature, that involvement of the spleen was found in 30 per cent of all abdominal injuries. This figure is thought to be high. In any event, the usual signs of an acute surgical belly plus the

classical signs of internal hemorrhage with or without a history of injury should lead the surgeon to consider rupture of the spleen as a very definite possibility. Evidence of shock may be pronounced or surprisingly slight. The difficult cases from a diagnostic standpoint are those in which a delayed rupture constitutes the disability. Santini *et al.* in discussing delayed splenic rupture suggest that three stages may be considered: (1) the original injury, (2) the latent period, and (3) the period of acute intraperitoneal hemorrhage. The ideal thing would be to make the diagnosis and perform

ctomy in the latent period. However, Harkins in a review of 177 cases of ruptured spleen, mention only 1 case in which a diagnosis was made in the so-called latent period.

*Banti's disease.* The three remaining conditions in the foregoing list for which splenectomy is indicated may be regarded as the medical triad of splenectomy as a therapeutic measure. From the standpoint of incidence, occurrence and precedence and from the point of seniority, Banti's disease heads the list. In Johnston's report in 1908 of 708 splenectomies, 53 of which comprised Bessel-Hagens (14) series (1900), 61 were for splenic anemia, and in a series of 1,003 splenectomies reported by Pemberton and Kiernan in 1945, 272 were for splenic anemia.

This fascinating, controversial, and mysterious disorder, thought by many to be a syndrome rather than a disease *sui generis*, was first described by Banti in 1882. Fundamentally it is characterized by an anemia associated with splenic enlargement, cirrhosis of the liver, and ascites. The white blood count in Banti's disease is characteristically low—between 2000 and 3000.

While it has been true from the beginning that a lack of knowledge as to the etiology and nature of the disease has seemingly been essential for its diagnosis, a far clearer conception appears to prevail today than formerly. That Banti's disease and splenic anemia are one and the same condition, with the title of Banti's disease being reserved for the late stages, is a generally accepted postulation. Banti himself in reporting a series of 36 cases in 1910, divided the disease into three stages. The first stage was that characterized by anemia and splenomegaly, the second stage by cirrhosis of the liver, and the third stage by ascites. Suffice it to say that certain factors or circumstances are of definite prognostic significance and foretell the response of a patient with Banti's disease to splenectomy. Chief among these conditions, it would appear, is the matter of the existence of concomitant liver damage, and in the main this tends to correspond with the duration of the disease.

As early as 1907 Herrick expressed his views relative to the cause of increased portal pressure in portal cirrhosis. However, it was not until relatively late years that the existence of back pressure in the splenic vein has come to receive considerable emphasis as a factor in Banti's disease. Whether this hypertension in the splenic vein is a cause or an effect is a moot question in the minds of some. Thompson, Whipple *et al.* (64) have contributed appreciably to the expression of

thought upon this matter. A most comprehensive report bearing upon this subject was recently published by Whipple (67).

It was Thompson's view originally that cirrhosis of the liver was only one obstructive cause and that if splenectomy was instituted before it developed, the subsequent development of splenic anemia would be prevented. Why this should be true, if it is, is still not readily understood. In any event the theory has been advanced and considerable substantiating evidence offered by these authors, to the effect that pressure in the portal system from any cause such as schistosomiasis, neoplasm, thrombosis of the portal vein, or cirrhosis of the liver, which would tend to increase the back pressure, can produce the clinical picture of Banti's disease. It is upon this predication that the contention for referring to the symptom complex as a syndrome rather than a disease is based.

The class of cases in which the response to splenectomy is most gratifying is generally agreed to be that in which there is increased tension in the splenic vein without demonstrable evidence of liver damage. While it may be granted that portal hypertension is a dominant factor in the etiology of Banti's disease and that the consequent back pressure in the spleen may produce a physiological imbalance that would in time affect the whole hematopoietic system, it is at the same time difficult to comprehend how removal of the spleen would eliminate the factor causing the portal hypertension and thus arrest whatever tendency there might be toward a development of cirrhosis of the liver. Indeed certain surgeons and pathologists believe that the only cases of Banti's disease in which benefit will follow splenectomy are those in which a thrombosis of the splenic vein exists between the spleen and its junction with the portal vein. In this type of circumstance the deleterious effect of a physiologically deranged spleen on the bone marrow is eliminated. It is, moreover, a concept of this school of thought that in order to achieve maximum benefit from surgical intervention in Banti's disease, in addition to splenectomy, the tributaries of the splenic veins with the gastric veins should be ligated to prevent a backing up of blood into the gastric and esophageal veins with the resultant development of varices and hemorrhage. While, theoretically, this measure may be based upon sound reasoning, its accomplishment is not simple and it is believed that it is seldom undertaken.

The anemia in Banti's disease is believed by certain individuals to be due to a pressor effect of the spleen on the bone marrow probably through a hormonal action or some internal secretion.



Naegeli (52, 53) was a leading exponent of this view. The removal of the spleen in these blood dyscrasias relieves the bone marrow of the influence of the spleen and permits the release of the various elements manufactured by it into the general circulation. It is interesting and baffling to note that in none of the blood dyscrasias previously listed and benefitted by splenectomy was there histopathological evidence of what the mischievous making mechanism in the spleen may be.

Certain findings are of ominous prognostic import and are regarded by some as contraindications to operation. High on this list of unfavorable indications are ascites and hemorrhage from the esophageal or gastric varices. According to Hanrahan, the existence of a microcytic or pseudomicrocytic anemia indicates a pathological change in the liver and implies an impending exodus regardless of whether or not surgery is done. Statistics indicate that while splenectomy in Banti's disease is frequently not attended by improvement of the patient's condition, by and large, it offers the patient more than any other therapeutic agent or measure yet introduced. It is "the one proved life saver in Banti's disease" (Babcock).

In advanced cases of Banti's disease it is likely that the spleen will have become so adherent as to make its removal virtually impossible without a grave risk of precipitating a fatality and, moreover, it is contended by some surgeons that the tendency toward hemorrhage from varices might be increased by splenectomy if a collateral circulation or bypass for venous blood has become established through the spleen. To understand the mechanics requisite to satisfy this situation, it is necessary to visualize that collaterals have developed in the dense adhesions between the spleen and the diaphragm, through which the venous return could be shunted into the general circulation (a circumstance which would render the removal of the spleen too hazardous and too dangerous). Also, the blood leaving the spleen by way of the vasa brevia and then entering the left gastric vein is, in its turn, shunted into the esophageal veins which enter the left gastric vein, and is ultimately backed through the esophageal veins into the azygous system; it then enters the vena cava and by-passes the liver. This backing-up process may go on so far as to force a reopening of the venous tributaries which have lain more or less dormant since fetal life, and to dilate others whose function has been of a limited nature. Thus the umbilical veins and veins of the round ligament may become enlarged and the phenomenon characterized by varicosities on the anterior

abdominal wall, sometimes referred to as Courviellier-Baumgarten's syndrome, or a caput medusa, is produced. It is a notable fact that hematemesis which develops or increases following splenectomy is of grave prognostic significance.

As a refresher on the anatomical relationship of the portal and general circulations and as an aid to a better understanding of the mechanics involved in the development of varices of the esophagus and abdominal wall as a consequence of portal obstruction, Figure 3 has been prepared.

**Congenital hemolytic icterus.** The next of the so-called medical triad, in order of frequency of occurrence as well as in time elapsed since it first received recognition as a clinical entity, is congenital hemolytic icterus or spherocytic icterus. Having been first discovered by Minkowski in 1900 and Chauffard in 1907, it is sometimes referred to as acholuric familial jaundice of the Chauffard-Minkowski type.

This disease is usually thought to be congenital, but it may be acquired. If acquired, it is known as the Hayem-Widal type (Babcock). Thompson (65), in 1939, reported 43 cases of hemolytic jaundice seen over an 18 year period at the combined splenic clinic of the Columbia Medical Center. Splenectomy was performed upon 30 patients of this series. In 1945, Pemberton and Kiernan reported 233 splenectomies at the Mayo Clinic for hemolytic jaundice between the years 1904 and 1944. Also, in 1945, James and Evans reviewed 15 cases of acquired hemolytic jaundice with onset after the patients were 50 years of age and found that 5 showed improvement after splenectomy. Of these patients, 3 were past 70 years of age.

The diagnosis of this disease is based upon recurring attacks of jaundice of varying degree without increase of bile in the urine and without evidence of diminution of bile in the stools. The jaundice is due simply to an inordinate destruction of the red blood corpuscles. There is characteristically a pronounced anemia which is frequently severe. The blood corpuscles, as seen on a smear, tend to be microcytic and spheroidal rather than discoid in shape. Reticulocytes and nucleated red cells are common in the peripheral circulation. Equally as important as any single finding in this disease is an increase in the fragility of the erythrocytes. It is interesting to note that while neither the degree of fragility nor the presence of spherocytes in the peripheral circulation is apparently affected by splenectomy, the patient's improvement may be phenomenal.

Furthermore, it is interesting to note that according to Kirkegaard and Kirkegaard, the duration of life of the erythrocytes in patients

with hemolytic jaundice is from one-tenth to one-twentieth of the duration of life of normal erythrocytes. These authors also point out that in acquired hemolytic jaundice, the erythrocyte and reticulocyte counts and the hemoglobin percentage may be expected to reach their original value from 4 to 6 days after a transfusion. Thus, it is seen that normal erythrocytes live only from one-fifth to one-tenth their normal lifetime when transfused to patients with hemolytic jaundice. The role of the spleen in the pathogenesis of this disease is reckoned by Kirkegaard and Kirkegaard to be a dominant one.

Biopsy of the bone marrow in this condition is of diagnostic assistance in that spherocytes are found in the bone marrow and the erythroid precursors preponderate over the myeloid to an inordinate degree.

The mechanics of why the spleen enlarges and why the patient becomes anemic with this disease seem fairly readily explainable on the theory that because of their shape, spherocytes will not pass the interstices or the filter structure of the spleen and are therefore filtered out, which causes at the same time a paucity of circulating cells and splenomegaly. This, however, as Thompson (65) points out, still leaves unanswered, three questions: (1) What is the genetic origin of spherocytes? (2) Why the jaundice? Why the associated destruction of the red blood cells? (If the answer is in increased fragility, the question of why is yet equally in order.) and (3) What is the role played by the spleen of an individual affected with spherocytic jaundice that a normal spleen would not play. Granted that the anemia is relieved by removing the trap or filter, the question as to why the fragility remains unchanged in an appreciable number of cases is still unanswered.

A most interesting and surprisingly common concomitant finding in cases of hemolytic icterus is the presence of gall stones. The incidence in Pemberton and Kiernan's series of 233 cases reported from the Mayo Clinic was 71.2 per cent. That gall stones form as a result of the constant excess of bile pigment from the protracted hemolysis of the red blood corpuscles seems logical. In any event, the symptoms of gall stones sometimes predominate and lead to surgical intervention for cholelithiasis.

While "familial" is a qualification commonly applied to this disease, Thompson (65) does not believe that a history of familial occurrence is of differential diagnostic importance.

*Essential thrombocytopenia.* Lastly we come to consider the junior member of the trinity of spleen-influenced blood dyscrasias—purpura hemor-

rhagica, or thrombocytopenic purpura. Splenectomy for this condition was first introduced by Kaznelson, a student in Prague in 1916. There are two more or less definite forms, the acute and chronic. The results commonly obtainable from splenectomy for this condition are dramatically brilliant. In the acute form, there is justification for deliberating only long enough to determine whether medical measures will be effective. The mortality rate from splenectomy in the acute form or during an acute exacerbation is much higher than when the operation is performed during a quiescent phase. However, it is dangerous to wait and certainly there is no more certain means of bringing about a cessation of purpuric hemorrhage than by splenectomy.

In chronic thrombocytopenic purpura, the results from splenectomy are uniformly more gratifying than from any other condition in which splenectomy is indicated, save for ruptured spleen. The incidence of the disease is about on a par with spherocytic hemolytic anemia. Pemberton and Kiernan reported 153 cases over a 21 (1923-1940) year period at the Mayo Clinic, and Elliott, of Columbia Medical Center, New York, reported 42 cases seen over a period of 10 years, upon 22 of which splenectomy was done. The diagnosis of thrombocytopenic purpura hinges chiefly upon the finding of a low platelet count in an anemic patient with purpuric manifestation. There is also a long bleeding time with a normal clotting time. The clot is slow to retract. There is an absence of premature cells and the regenerative propensities of the blood forming mechanism are apparently normal. The spleen is not characteristically enlarged and, as is pointed out by Hayden, it is the only condition except ruptured spleen in which splenomegaly is not part of the indication for splenectomy. Sternal puncture is important in that, by this measure, aleucemic leucemia and aplastic anemia which are extremely difficult to differentiate from hemorrhagic purpura can be ruled out.

#### COMMENTS UPON OPERATIVE TECHNIQUE

The operative technique in splenectomy has been fairly well standardized for a long time. Aside from a few suggestions which the author believes may be worthy of mentioning, the reader will not be burdened with a detailed description of the surgical removal of the spleen. It has often been said by experienced surgeons that a splenectomy may be one of the simplest of operations, or it may be impossible, and that the competency of the surgeon in surgery of the spleen may be gauged chiefly by his ability to differentiate be-

tween an operable and an inoperable spleen. The one important point to remember is that, unlike certain other operations, the operation of removing the spleen is, in most instances, not one which will lend itself to compromise. Once the surgeon has decided to remove the spleen—and in case of rupture there is virtually no alternative—he should set about it in a bold and methodical manner. Troublesome adhesions are more apt to be present in Banti's disease than in any other condition for which splenectomy is indicated. When these adhesions are dense and extensive the wiser policy is to regard the spleen as inoperable, because after the pathological process has advanced to a stage where the adhesions interfere seriously with removal of the organ the clinical course of the disease will not (unless adversely) be affected by its removal. The manner in which the effect of splenectomy may prove detrimental has been alluded to in the discussion of Banti's disease.

In the anatomy books there are described several ligaments, chief among which are the phrenicosplenic ligament and the gastrosplenic ligament, whose function it is to hold the spleen in position. These ligaments, in reality amount to nothing more or less than peritoneal reflections (Figures 4, 5, and 6). The strongest is the phrenicosplenic ligament which merges with the gastrosplenic ligament. When the ligamentous attachments of the spleen are redundant and permit preternatural mobility, the spleen may become dislodged from its fossa and descend even into the pelvis. Hence the term "wandering spleen."

According to the writings of earlier surgeons, a "wandering spleen," particularly when it became twisted upon its pedicle, was a more or less common indication for splenectomy. Indeed the prominence assigned to this condition as an indication for splenectomy by earlier and more modern authors prompts this author to stray afield in order to comment briefly upon it. It is amazing to note that among the series of 708 splenectomies reported by Johnston in 1908, which number contained Bessel-Hagen's (14) series of 353, ectopy associated with either idiopathic or malarial hypertrophy was listed as the indication for splenectomy in 139 cases, and in 30 of these the pedicle was twisted. In the report by Whipple (68) of 1,437 cases seen at the combined splenic clinic of Columbia Medical Center over a 10 year period, 20 conditions in which the spleen played a dominant role were listed but ectopy or "wandering" spleen was not mentioned. In 646 splenectomies performed at the Mayo Clinic up to 1934 and reported by Mayo and Giffin, ectopy

constituted the indication only twice. Subsequent to 1934, in the 357 additional splenectomies (making a total of 1,003 by January 1, 1945) at the Mayo Clinic (Giffin), ectopy was not encountered in a single instance. This writer has never seen a spleen so mobile and displaced to such degree as to qualify it for the designation of "wandering" spleen. Of course, in certain cases of general viceroposis, the spleen may be found, along with the stomach, in the lower part of the abdomen.

In any event, the several ligaments may, in most instances (Banti's disease is a notable exception), be separated from the spleen without difficulty by passing the hand around the organ and separating it from its ligamentous attachments. If extraordinary resistance is met by the hand, the ligaments may be readily divided by the use of scissors. A note of warning should be sounded apropos the use of scissors on the gastrosplenic ligament since it is entirely possible for one to enter the stomach inadvertently without being aware of it. The separation of the spleen from its ligamentous attachments always seems more readily accomplished with a ruptured spleen.

This is fortunate because expedition in delivery is usually more vitally essential in this condition. Nevertheless, whatever may be the reason for splenectomy, expeditious delivery of the spleen from its fossa and into the abdominal wound is highly desirable. Many operators speak of short pedicles and difficult delivery of the spleen. If the incision is high and long enough, this writer believes that no spleen should be difficult to deliver because of the length of its pedicle. The important circumstance provided by the delivery of the spleen is the exposure of the pedicle, which renders accessible the major vessels (Fig. 4). Ideally, it is contended that the splenic artery should be identified and ligated first, to be followed by gentle massage of the spleen or even the introduction of 2 cubic centimeters of pituitrin into its pulp by means of a syringe and needle, immediately prior to ligation of the splenic vein. The reason is that by an observance of this technique, a definitely appreciable amount of blood (in large spleens, 500 c.c. or more) can be conserved. An aneurysm needle seems to have been handed down as the classical ligature carrier for passing the ligature around the splenic vessels. Actually, few surgeons try to identify and ligate the large vessels independently but, instead, they seize the whole pedicle by means of several large and reliable clamps and apply and securely tie "stick ties" upon removal of the clamps. Whether absorbable or nonabsorbable ligature material is

used seems to make no difference. When the spleen is first delivered into the wound, its fossa, or that area bounded by the diaphragm above, and the stomach (mesially) should be packed with several large, hot, wet laparotomy sponges which are left in place until ligation of the pedicle has been completed, when they are removed and the abdomen is closed.

The only hazard of any consequence in removing a ruptured or nonadherent spleen is that of hemorrhage from the pedicle due to tearing of the veins, which are sometimes extremely frail in structure by the ligatures. While one of the accidents which seasoned surgeons warn against is that of tying the tail of the pancreas in the ligatures placed upon the splenic vessels, the writer has deliberately included a small portion of the tail of this organ in the vessel ligatures in several instances to safeguard against their cutting through, and has witnessed no deleterious effect from such procedure. The only other score upon which serious trouble may arise in connection with splenectomy is, as has been mentioned, the accidental entrance of the stomach. This occurred in 1 of the cases reported in the accompanying series but was promptly recognized, and following closure of the rent, which was 2 inches in length, no untoward development ensued.

Two postoperative complications alleged by numerous observers to follow splenectomy are phlebitis of the splenic and portal veins, and the development of thrombi. The latter is said to be particularly likely to occur following splenectomy for Banti's disease and is explained on the basis of an increase in the blood platelet count due to the removal of the spleen combined with retardation of the blood flow through the portal vein incident to the inherently present portal hypertension. Such may have been the explanation for the sudden death of a patient 11 days following splenectomy for Banti's disease, which was done by the author on a native in Guam 10 years ago.

While thrombosis of the portal and splenic veins may not be uncommon following splenectomy for the several blood dyscrasias in which the operation is indicated, or for an organic disease of the spleen, it has rarely, although occasionally, been reported in association with splenectomy for a traumatic spleen (Weissenborn and Gius *et al.*). The symptoms which should lead the surgeon to suspect a postoperative thrombosis of the portal vein are prolonged, severe abdominal pain, abdominal distension, increased white blood and platelet counts, and an increased sedimentation rate. Heparin and dicoumarin are advocated as

useful therapeutic agents in the prevention and management of this complication.

#### PHYSIOLOGICAL EFFECTS OF SPLENECTOMY

The introduction of a detailed review of the various physiological changes alleged to result from splenectomy would be superfluous in this paper. Suffice it to say that certain of the changes, such as a moderate secondary anemia, are due in part at least to the loss of blood at operation and are of only transitory import. Pfeiffer and Smyth have called attention to certain changes manifested in the blood picture which persist only for several months and are inconsequential. The remaining changes, such as those indicative of a disturbance in the metabolism of iron, are understandable, and that these various changes are evident for only a few weeks is also understandable in view of the fact that the function of the spleen is taken over by other organs of the reticuloendothelial system. The color of the bone marrow is said to change from a yellow, fatty appearance to a red hyperplastic type because of a lack of the restraining influence of the spleen. It is in no wise apparent that this makes any difference to the welfare of the individual.

#### MORTALITY RATE

If the question of when and by whom the first splenectomy was performed has a rival on the score of multifarious and widely divergent opinion, it must be the question of the mortality rate from splenectomy. The mortality rates for variously reported series of splenectomies range all the way from 100 (Russell, and also a report of the National Research Council) to 0 per cent (Grove). On the whole, however, splenectomy has always been attended by a mortality rate of sufficient proportions to warrant its being regarded respectfully and as a surgical procedure of the first magnitude. It is manifestly difficult to obtain from the literature, an accurate account of the mortality rate from splenectomy because of the inherent tendency of operators to report only their successful results. In any event, the over-all mortality rate is undoubtedly lower today than that of 20, 15, or even 10 years ago. This is due to a combination of factors including the steady improvement in diagnostic methods, a better understanding of the indications, better preoperative and postoperative care of the patient, better operating facilities, including anesthesia, and better training and organization of medical personnel. The following references will serve as a fair index of the trend in mortality rate from splenectomy.

## INTERNATIONAL ABSTRACTS OF SURGERY

TABLE 1. — SUMMARY OF CASES.

Case	Sex	Age	Admission Date	Admitting Diagnosis	Established Diagnosis	Date of Splenectomy	Comments
1	M	46	11-14-42	Banti's disease	Banti's disease	10-27-43	Patient well, 3 years postoperatively.
2	M	20	11-16-42	Intracranial injury	Intracranial injury and ruptured spleen	11-16-42	Patient died of concomitant intracranial injury 20 hours postoperatively. Because of apparent preponderance of tenderness in the right side, a right rectus incision was made. The spleen was removed without difficulty through the right rectus incision.
3	M	23	12-27-42	Wounds, multiple	Ruptured spleen	12-27-42	Patient injured in airplane crash. Recovery complete.
4	M	21	3-20-43	Gastritis, acute	Rupture of spleen, delayed.	3-20-43	History indicated injury from blow over splenic area 3 months previous to admission to hospital. Recovery complete.
5	M	32	4-14-43	Undetermined tumor, abdomen	Cyst, spleen (Fig 2)	4-21-43	Recovery complete. Large solitary true cyst. (Fig. 2)
6	F	23	5-8-43	Ruptured ectopic pregnancy	Ruptured spleen, spontaneous	5-8-43	Recovery complete. No history of any antecedent trauma could be elicited from the patient.
7	M	22	8-7-43	Ruptured spleen	Ruptured spleen	8-7-43	Motor scooter accident. Patient was thrown against a rust steel cable which struck him over left lower posterior thorax.
8	M	56	8-20-43	Banti's disease	Hodgkin's disease	10-10-43	Patient's response to splenectomy was indifferent. Pronounced anemia persisted. Lived until 6-12-44, 8 months and 5 days from date of splenectomy. Postmortem examination revealed Hodgkin's disease of mediastinum, abdomen, and liver. On the basis of the autopsy findings, diagnosis was changed to Hodgkin's disease.
9	M	20	10-12-43	Purpura hemorrhagica	Purpura hemorrhagica	11-4-43	Recovery complete. Blood platelet count rose from 200,000 preoperatively to 590,000 postoperatively.
10	M	20	1-4-44	Ulcer duodenum perforated	Ruptured spleen, delayed (Fig 1A)	1-4-44	Because of erroneous preoperative diagnosis, right rectus incision was made. Spleen was removed without difficulty through this incision. Upon close questioning patient recalled having been struck on the left lower part of his chest, 2 weeks previously, by a thrown baseball.
11	M	30	1-24-44	Jaundice, hemolytic	Jaundice, hemolytic	5-11-44	Gall bladder contained stones. Patient under medical treatment with indifferent response for period of approximately 4 months prior to splenectomy. Recovery complete.
12	M	28	2-28-44	Banti's disease	Banti's disease	3-28-44	Recovery from operation uneventful. Liver noted to be small and nodular. Hematemesis was a pre-operative symptom. Patient died 2-12-45, almost 11 months following splenectomy.
13	F	21	3-20-44	Banti's disease	Banti's disease	4-11-44	Patient living and well 14 years after splenectomy. Spleen was 6 times normal size.
14	M	32	4-5-44	Banti's disease	Hodgkin's disease (Fig 1B)	4-11-44	Spleen weighed 1,950 gm. Histopathological examination revealed findings characteristic of Hodgkin's disease. This patient died suddenly 6-22-44, 10 weeks following splenectomy. Post-mortem findings indicated: (1) Hodgkin's disease of the abdominal and mediastinal lymph glands and liver; (2) acute cardiac dilatation.
15	F	21	6-9-44	Thrombocytopenic purpura	Thrombocytopenic purpura	6-10-44	Recovery complete. Platelet count, 46,000 immediately preoperatively. Rose to 120,000 on afternoon of operative day; 377,000 on ninth postoperative day. One year following operation, patient was symptom-free.

In 1880, Russell reported a mortality of 100 per cent for rupture of the spleen in a series of 28. The number of patients upon whom a splenectomy was done is by no means clear from Russell's report. In 1900, Bessel-Hagen (13) reported 37 splenectomies for ruptured spleen with 20 recoveries and 17 deaths, a mortality rate of 47 per cent. Bessel-Hagen's entire series comprised 360 splenectomies for a variety of causes, with 138 deaths, or a 38.5 per cent general

mortality. In 1907, Berger collected from the literature and reported a series of 135 splenectomies with a mortality rate of 38.7 per cent. In 1908, George Ben Johnston reported 108 splenectomies for rupture with 51 deaths, or a mortality rate of 40 per cent. Johnston's series comprised 708 splenectomies with an over-all mortality of 27.4 per cent. In 1908, Lotch reported 138 cases with a mortality of 37 per cent. In 1909, Brog-sitter found the mortality rate to be 35.3 per cent

# PUGH: SPLENECTOMY, WITH REFERENCE TO HISTORICAL BACKGROUND

in a collected series of 203 splenectomies. Willis, in 1919, found that the mortality rate for splenectomy for traumatic rupture was 28.8 per cent. Buxton, in 1922, reviewing cases up to that time found the mortality rate for all causes to have been 28.8 per cent. Beer and Rosenthal, in 1926, reported 90 splenectomies in which there were 38 deaths, or a mortality rate of 31.1 per cent. In 1926, Quenu estimated the general mortality rate for adults above 20 years of age to be 32 per cent and for individuals under 20 years of age, 14 per cent. In 1928, Connors reported 39 cases with a mortality of 40 per cent. In 1930, Dretzka reported 27 cases with a mortality rate of 33.3 per cent. In 1933, Roettig *et al.* reported 22 ruptured spleens in the city of Columbus, Ohio over a 12 year period. Eleven (11) splenectomies were done, with 1 death, a 9 per cent mortality rate of 8.5 per cent. Four (4) traumatized spleens were packed with no deaths. For the whole series there were 7 deaths among 22 cases, or a mortality rate of 31.8 per cent. For the entire 1,003 splenectomies performed at the Mayo Clinic over a period of 40 years, reported by Pemberton and Kiernan in 1945, the over-all mortality rate was only 9.4 per cent. Since 1941 there has not been a single operative death from splenectomy at the Lahey Clinic, Boston, Massachusetts.

In a manual entitled "Abdominal and Genito-Urinary Injuries" published in 1942 under the auspices of the National Research Council and intended as a guide for service doctors, it is stated, on page 96, that splenectomy for splenic trauma "in the experience of the American Expeditionary Force in the war of 1917 to 1919, was associated with a mortality of practically 100 per cent." In contrast to this, suffice it to say that the best statistics available at this time would indicate that the mortality rate from splenectomy in the Armed Forces during World War II was between 10 and 20 per cent. Complete data for splenectomies in the Navy are not available at present; however, for noncombat injuries, the Navy statistics indicate that from 1942 to 1944, there were 61 splenectomies for ruptured spleen with 5 deaths, or a mortality rate of approximately 8 per cent.

During 26 months, from 1942 to 1944, the author performed 15 splenectomies for a variety of causes (see Summary of Cases) with 1 death, or a mortality rate of 6 per cent. Actually, however, to register this case as a debit on the splenectomy ledger is not only to "lean over backwards" but indeed to vitiate statistics, since it was wholly self-evident that the major disability,

and that responsible for death, was a concurrent severe intracranial injury associated with fractured skull.

## SUMMARY

1. The literature bearing upon splenectomy, past and present, has been reviewed.
2. The various functions ascribed to the spleen have been enumerated and briefly commented upon.
3. The conditions for which surgical removal is indicated have been discussed with special reference to diagnosis and the rationale of splenectomy.
4. The mortality rate reported by various individuals of an earlier era has been compared with the more modern reports.
5. Photographs and drawings depicting several splenic disorders and illustrating anatomic details of importance surgically, as well as rendering understandable certain clinical phenomena, are published.
6. A series of 15 splenectomies with their respective indications is reported.

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# ABSTRACTS OF CURRENT LITERATURE

## SURGERY OF THE HEAD AND NECK

### HEAD

Clarkson, P., Wilson, T. H. H., and Lawrie, R. S.: *The Treatment of Jaw and Face Casualties in the British Army. Ann. Surg.*, 1946, 123: 190.

The authors present an account of the treatment and results in 1,000 jaw casualties which were treated in the North African and Italian campaigns prior to November, 1944. Of these 1,000 cases, 700 were the result of missiles, and 50 of these were major pharyngeal or palate wounds. The remaining 300 were closed wounds and were due for the most part to vehicle accidents or brawls.

The author divides the treatment of the maxillo-facial casualty into three fundamental periods, the first of which is the early treatment, next the intermediate treatment, and finally the late treatment. In the early phases, the problem is chiefly one of dental fixation. The associated soft tissues should be closed early, that is, up to 36 hours. The dead tissue should be removed, although a minimum amount of tissue should be sacrificed. A cosmetic closure should be effected in so far as possible, and then penicillin should be given. (The author states that he has had no fewer bony infective complications since he has used penicillin.) In the upper pharyngeal wounds the track should be cleansed and closed. In the lower pharyngeal wounds there is usually more infection but he still believes that cleansing the wound and closure is the treatment of choice. In early comminuted mandibular fractures he removes only the detached or infected bone. He does not believe in dependent prophylactic drainage. In antral lesions a nasal antrostomy is done; radical surgery and closure with the minimal sacrifice of bone completes the phase. In all cases early fixation of the fragments is advised except when there is an inordinate amount of edema of the tongue or nasal obstruction, for then swelling and the possibility of suffocation are too great a hazard.

Wire fixation was used in the majority of cases and was found to be most satisfactory. The problem of an airway presented itself very seldom. A complete upper respiratory obstruction or a gross intraoral obstruction was the only condition necessitating tracheotomy.

The problem of removing teeth located in the fracture site is still unanswered, but the authors believe that the teeth should be left in place if they contribute to the maintenance of the reduction, with the idea that they can be removed subsequently.

Usually the patients are kept on intravenous feedings for 2 or 3 days. There were 4 cases in which gastrostomy was done and the local treatment consisted chiefly of special attention to oral hygiene.

In the intermediate care the problem resolves itself into the treatment of the infective complications of the bones and teeth and definitive fixation. Fixation with splints, as mentioned, is most successfully done by the use of wire. Sectional cast silver closed caps and acrylic caps have been used but for the most part they are cumbersome.

Circumferential wiring was done in 45 cases with fixation for from 4 to 6 weeks. Extraoral Roger Anderson pins were used in 15 cases, 8 of which had infections around the pins. This type of fixation was not solid enough to prevent subsequent deformity. Interosseous wiring was used in 15 cases and was uniformly satisfactory in the treatment of edentulous posterior fragments in linear closed fractures.

Postoperatively, the most common cause of fever was infected bone. If the wound is not healed in 4 or 5 weeks, the likelihood of infected bone is sufficient to warrant surgical exploration. If the wound does not heal in 8 weeks, a wide incision is made with removal of questionably involved bony fragments and drainage.

The problem of secondary hemorrhage can be controlled almost uniformly by packing. In 6 cases the uncontrolled arterial bleeding was stopped by ligation of the ipsilateral external carotid artery.

The late treatment for the most part was concerned with bone grafts, the correction of scars, epithelial inlays, and trismus. Cancellous chip bone grafts were used in 14 cases and it was found that a gap of 1 cm. was united in 32 days, while one of 6 or 7 cm. was united in 90 days. An iliac donor site was found to be simple, safe, and certain.

Scar contractures were usually treated from 1 to 4 weeks after final healing of the wound.

Epithelial inlays were used for the most part to deepen the buccal sulcus.

The problem of trismus was treated prophylactically by the use of chewing gum and a wedge, and, if persistent, by dilatation under anesthesia.

The results in 110 cases of fracture of the horizontal ramus revealed that a severe comminution delayed union only about 2 weeks; that these cases often needed sequestrectomy; that early surgery, i.e., within 48 hours, reduced the incidence of infections; that soft tissue damage is not important in the rate of healing of the bones; and that early care by untrained personnel resulted in three times as many late infections.

Again, in 190 cases of angle fractures the soft tissue injury was not related to the rate of union; non-reduction of the posterior fragment delayed union.

Three weeks of occlusal fixation of 128 condylar fractures followed by full function resulted in no cases of trismus.



## INTERNATIONAL ABSTRACTS OF SURGERY

Eighty-nine incomplete fractures were not treated by fixation, but simple closure of the mucous membrane was done, without incident in every case.

It was observed among 220 maxillary fractures that their importance was chiefly dependent upon their complications; namely, eye damage in 25 per cent of the cases, major hemorrhages in 10 per cent of the cases, and fracture of the anterior cranial fossa with brain injury which, though very uncommon, caused two-thirds of the deaths in the entire series.

For antral maxillary fractures, minimal removal of tissue and bone, nasal antrostomy, and closure of the soft tissue when possible were done.

In fractures of the maxilla, nasal obstruction was often complete enough to warrant a serious consideration of tracheotomy. However, by waiting from 5 to 10 days for the preliminary edema to subside and then effecting intermaxillary fixation, tracheotomy was avoided and therefore this was the preferred procedure. In floating maxillary blocks, a head band with vertical blocks was used.

Antral infections occurred in 15 per cent of the cases. In only 2 per cent of these maxillary fractures was a Caldwell-Luc operation needed.

Among the 1,000 cases 33 patients died. Four of the deaths were not due to the fracture. Fourteen deaths were due to the brain injury and the remaining 15 resulted from the maxillofacial injury. The early deaths in the last group were the result of hemorrhage and suffocation; the late deaths were due to lung complications. LOUIS T. BYARS, M.D.

## EYE

Somerville-Large, L. B.: An Operation for Posterior Route Extraction of Intraocular Foreign Bodies. *Brit. J. Ophthalmol.*, 1946, 30, 208.

In the present article, the author describes a new operation for posterior route extraction of intraocular foreign bodies, which he employed in 24 cases.

With this procedure, the sclera is opened with a trephine, the area of the trephine hole in the choroid is coagulated by diathermy, and no scleral sutures are used. After the 1.5 mm. trephine is made (with care to avoid injury to the choroid), the choroid is coagulated through the trephine hole. The tip of the magnet is made to enter the trephine hole and the power is switched on for periods of from 2 to 4 seconds. The magnet is applied for a total of 15 minutes before it is decided that the foreign body is non-magnetic or too embedded. After conjunctival sutures are inserted, penicillin and atropine are instilled, and both eyes are closed.

If a diathermy apparatus is not available, the choroid can be scarred through the trephine hole with the actual cautery.

The advantages of this procedure are as follows: the apposition of a powerful magnet point as near the foreign body as is compatible with safety; a minimum choroidal scar, and the absence of postoperative fundus hemorrhages and vitreous opacities. JOSHUA ZUCKERMAN, M.D.

O'Donovan, W. J., and Michaelson, I. C.: Epidemic Keratoconjunctivitis Associated with Skin Lesions. *Brit. J. Ophthalmol.*, 1946, 30, 103.

The authors discuss the association of skin lesions with epidemic keratoconjunctivitis. They point out that this association has not been previously reported in the literature.

In 33 cases the condition was associated with the following affections of the skin: seborrheic dermatitis, 18 cases; severe acne, 2 cases; chronic blepharitis, 6 cases; impetigo, 2 cases; severe acne and impetigo, 1 case; dermatitis of the ear lobe, 1 case; arsenical dermatitis, 1 case; and syphilis barbae, 1 case. It will be noticed that most of the lesions were of the seborrheic type.

Thirty-three of a series of 66 patients with keratoconjunctivitis had a concurrent affection of the skin; of these, 18 had an associated seborrheic dermatitis of the scalp or of the face which, in most cases, was ipsilateral. The skin lesions usually preceded the ocular condition.

The analogous nature of the skin lesions in herpes simplex, herpes zoster, and in certain cases of epidemic keratoconjunctivitis is suggested.

JOSHUA ZUCKERMAN, M.D.

Cockburn, G.: Ocular Cysticercus Cellulosae. Report of a Case of Parasite in the Vitreous. *Brit. J. Ophthalmol.*, 1946, 30, 65.

The author reports a case of ocular cysticercus cellulosae in the vitreous.

The patient stated that he first noticed a fog in front of his right eye and later an object "shaped like a pear-leaf" which had a "stem" which constantly changed position. The "stem" sometimes retracted into the "leaf" only the head projecting, the remainder swelling into a mass like an "electric bulb."

Examination of the right eye revealed evidence of a perforating injury several years previously; and in the lower part of the vitreous a lustrous blue-green to russet-brown and lemon spherical cyst about 3 mm. in diameter, with a "tail" or scolex at its lower margin. The miniature tapeworm constantly changed its position. The tension was normal. No palpable cysts could be found elsewhere in the body. Examination of stools revealed ova of ascariis, lumbricoides and oxyurias vermicularis, but no segments of taenia.

The cyst was removed by means of a scleral hook introduced into the vitreous. The surgical procedure corresponded to that used in magnet extraction, the wound in the sclera being surrounded by a barrage of cautery applications.

JOSHUA ZUCKERMAN, M.D.

Fraser, I. G., and Scott, A. A. B.: Penicillin Treatment of Ocular Inflammation. *Brit. J. Ophthalmol.*, 1946, 30, 168.

Of 38 patients under treatment for ocular inflammation, all but 1 were hospitalized. Before starting treatment, bacteriological examination and tests for

# SURGERY OF THE HEAD AND NECK

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penicillin sensitivity were made. As a rule, treatment was commenced on admission of the patient, without waiting for the bacteriological report. In later cases, cultures were taken as a routine every 48 hours, and treatment was continued for a few days after negative cultures were obtained. In the majority of cases a solution of the sodium salt containing 500 units of penicillin per cubic centimeter (occasionally 250 units) was used—three or four drops being instilled every 4 hours. In 8 cases, lamellae of calcium salt containing 180 or 100 units, were applied every 4 hours. One patient with a perforating injury received an injection of 1,250 units of sodium salt in 0.25 cubic centimeter of sterile distilled water into both the anterior chamber and the vitreous.

Most cases of blepharitis were of long duration. Twenty patients were treated. Of these, 9 showed apparent clinical cure and 9 were greatly improved; 1 showed a marked local reaction to penicillin and treatment had to be stopped.

Four patients with acute conjunctivitis were cured. Of 8 cases of conjunctivitis with a corneal lesion, 5 were cured and 3 showed no apparent response to penicillin.

Of 6 patients with keratitis or corneal ulceration, 4 were cured; 2 failed to respond to penicillin and required other treatment.

Treatment of perforating injury in one patient failed.

Lamellae containing 100 or 180 units of penicillin were used in 9 cases. As compared with the solution, they have the advantage of easy storage, require no refrigeration, and are immediately available. Their disadvantage is that they are highly deliquescent, and cause some smarting and conjunctival irritation.

Two patients with Eales' disease received benefit from penicillin therapy. The tables which accompany this article are well worth perusal.

Brown, C. A.: Penicillin in Ophthalmology. The Bacteriological, Experimental, and Clinical Evidence of Its Value, Including a Personal Series of 125 Cases. *Brit. J. Ophth.*, 1946, 30: 146.

LESLIE L. MCCOY, M.D.

## I. BACTERIOLOGY

1. Resistance of the organisms.
  - (a) Different organisms. The original classification of gram positive organisms as penicillin sensitive, and gram negative organisms as insensitive, broadly speaking, still holds good. The staphylococcus aureus and the streptococcus pyogenes are very sensitive while the pneumococcus is quite insensitive.
  - (b) Different strains of the same organism. Penicillin sensitivity varies widely with different strains of the same organism.
  - (c) Adaptation. By repeated subculture in penicillin, the resistance of the staphylococcus was increased 3,000 times, but this rapidly decreased on further subculture.

without penicillin. It is hoped that loss of acquired resistance will prove to be the rule with the majority of organisms rather than an acquired permanent fastness, as is found when sulfonamides are used.

2. Concentration of penicillin.

From our present knowledge, it appears that a concentration of 1,000 units per cubic centimeter is best for the average bacterial ocular infection.

3. Acidity.

The acidity of penicillin is quickly lost in acid solutions and some loss occurs even in weak acids. Boric acid and adrenalin (1-500) inhibits the activity of penicillin.

4. Incompatibility.

With the exception of adrenalin hydrochloride and boric acid, it seems that all the commonly used drugs used in ophthalmology may be safely used with penicillin.

5. Effect on the tissue and cells. Penicillin is completely innocuous to the tissues and has practically no inhibitory effect on the leucocytes. The more pus and organisms that are present, the more striking are its effects.

## II. EXPERIMENTAL EVIDENCE

1. Penetration.

(a) External application.

(1) With drops of 2,500 units per cubic centimeter every 20 minutes and ointment of 2,500 units per gram every ½ hour it was found that penicillin did not penetrate the aqueous of rabbits.

(2) Drops or ointment of 500 units per cubic centimeter or gram went through an inflamed cornea in inhibitory concentration and remained 14 hours.

(b) Subconjunctival injection. By this method, penicillin appeared in the rabbit's aqueous after ½ hour, also in damaged human eyes. Small amounts reached the vitreous in ¾ hour.

(c) Intra-ocular injection. This is the best way to get a high aqueous concentration and to reach the vitreous sooner (¾ hour).

(d) Intravitreal injection. Antibacterial activity of the vitreous persists for at least 24 hours. The penicillin becomes fairly evenly distributed through the vitreous in 12 hours. More than 1 injection of pure penicillin, or the use of crude penicillin, usually caused slight permanent changes in the lens, vitreous, and retina.

(e) Intramuscular and intravenous injection.

- (1) Minute amounts were found in the

aqueous following large doses, especially after paracentesis, but none were found in the vitreous.

- (2) Small amounts were found in the vitreous and aqueous after moderate doses.

#### CONTROL OF INFECTION

##### 1. Corneal lesions.

Staphylococcus aureus pneumococcal infections of rabbit corneas were controlled by hourly drops. Treatment instituted within 1 hour of infection saves eyes that would otherwise be lost. After 24 hours, treatment was only slightly beneficial.

##### 2. Intraocular infection.

Infection was controlled in most cases by penicillin applied locally by corneal bath, with or without iontophoresis and with little or no ill effect from iontophoresis.

##### 3. Vitreous infection.

Without treatment all eyes were lost. If treat-

ment was delayed 24 hours, all eyes were lost. If 500 units were injected into the vitreous within 12 hours all eyes were saved.

#### III. CLINICAL EVIDENCE

Penicillin is the most effective treatment for acute mucopurulent conjunctivitis including ophthalmia neonatorum. Drops of 1,000 units per cubic centimeter should be used every 4 hours or oftener and continued 48 hours after apparent clinical cure. It has a real value in acute keratoconjunctivitis. Deep corneal involvement requires other care also. Superficial injuries are not likely to become infected if treated with penicillin.

Penicillin is established as the most effective therapeutic agent for acute superficial bacterial infections of the eyes. It is indicated in nonbacterial infections only if secondary bacterial infection is present or threatened. In deep ocular infections bacterial in origin, penicillin must be used in continuously high local concentrations. Its greatest value is as a prophylactic or early therapeutic measure.

LESLIE L. MCCOY, M.D.

TABLE I.—RESULTS OF PENICILLIN THERAPY IN THIS SERIES

##### (a) Superficial Infections

Type of case	Total number	No of cases clinically cured	No of cases improved	No of cases not improved	No of cases of relapse
Blepharitis					
(a) Acute	14	10	4	—	—
(b) Chronic	5	2	3	—	—
Conjunctivitis					
(a) Acute	31	30	1	—	4
(b) Chronic	3	3	—	—	—
Acute keratoconjunctivitis					
(a) Moderate	38	38	—	—	6
(b) Severe	11	10	—	1	—
Non-bacterial corneal infections	0	3*	—	6	—
Superficial injuries	5	5	—	—	—

\*Also had secondary (bacterial) infection.

##### (b) Deep Infection

Type of case	Total number	Clinical cure (subconjunctival injection)	Improved	Not improved (drops, subconjunctival, intravitreal, parenteral penicillin)
Deep keratitis (non-bacterial)	4	—	—	4
Infection of anterior segment				
(a) Traumatic	2	1	—	1
(b) Infective	5	1?	—	2
Infection of posterior segment				
(a) Traumatic	2	—	—	2
(b) Infective	1	—	—	1

Troncoso, M. U.: Diathermy in Glaucoma. *Am. J. Ophthalm.*, 1946, 29: 260.

A review of the literature available on cyclodiathermy procedures precedes the author's report of his own experiments on rabbits' eyes to determine directly the physiological bases of diathermic methods. Ordinary diathermy apparatus was used to coagulate the ciliary base and processes, and observation of the results was made with the slit lamp microscope after enucleation of the eye, which was followed by micropathological examination.

The author found that both Vogt's transcleral puncture method and the nonpenetrating diathermy of Albaugh and Dunphy caused severe inflammatory reactions and affected primarily the orbicular ciliary instead of the ciliary processes. The author therefore devised new surgical techniques for direct local coagulation of the ciliary base and processes. This was carried out via the posterior route through the sclera and an anterior route through the peripheral cornea. Both monopolar and bipolar electrodes were applied. A third technique, called "translimbal diathermy" was evolved, in which an electrode was used to penetrate the limbus obliquely and coagulate the ciliary bases and to leave a filtering aperture upon its withdrawal.

The author concludes that the results of diathermy of the ciliary body are in general unsatisfactory, notwithstanding several apparently successful experimental results which he obtained by means of his own technique. HUNTER H. ROMAINE, M.D.

#### EAR

Hall, I. S.: The Surgical Treatment of Deafness. *Irish J. M. Sc.*, 1946, Ser. 6, 80.

The operation described follows closely the lines of the modified radical mastoid operation, the sole

difference being that in the modified radical operation the ossicles are left intact. The postaural approach is the author's choice.

The pedicle flap is an important part of the operation; it is taken from the roof and posterior aspect of the external auditory meatus, and is raised from the bone complete with *membrana flaccida*. The incus and the head of the malleus are removed. This gives complete exposure to the labyrinth. With the use of a dental drill an opening, from 3 to 4 mm. long by about 2 mm. broad, is made as far as possible over the ampulla of the horizontal canal as it enters the utricle. The flap is then placed in position and secured with paraffin packs, and the wound is closed in the usual manner.

In the selection of patients, it is better that they be young. The patient should not be too deaf as only 30 decibels can be restored. There must be no nerve deafness, and there should have been no previous middle ear disease.

The author presents the results obtained in 80 patients, all of whom were operated upon more than 5 months previously. The average percentage of improvement is 58.4 per cent.

JOHN F. DELPH, M.D.

Farquharson, I. M.: The Masking Effect of Sulfonamide When Used in the Treatment of Acute Otitis Media. *J. Lar. Otol.*, Lond., 1945, 60: 269.

A comparative study was made of the cases of acute otitis media occurring in the wards of the Edinburgh Royal Infirmary from 1937 (when sulfonamide was introduced) until 1944. The cases occurring in the previous 8 years were used as a comparison.

In presulfonamide days, 29 per cent of patients with otitis media developed mastoiditis; since then, only 13 per cent have developed mastoiditis.

For some time now the otologist has been aware that a change in the once familiar signs and symptoms of acute mastoiditis can occur after the administration of one of the sulfonamide drugs.

The drug, by its marked analgesic and antipyretic properties, tends to obscure the clinical picture, and often gives rise to a latent course of the disease that is responsible for the overwhelming pathological changes we so often see.

It is a matter for profound meditation that the drug which has produced such miracles in the treatment of otitic meningitis is the same drug which, used misguidedly, is indirectly responsible for the development of the disease itself—by masking symptoms that would have indicated surgical intervention.

The exhibition of sulfonamides is liable to change the ordinary case into an infection which is identical with that produced by the pneumococcus, type III; furthermore, how significantly altered must be our judgment when the two factors are combined; namely, the insidiousness of the pneumococcus and the masking effect of the sulfonamide.

At this juncture must be mentioned the masking effect of the drug when used after operation to control a febrile reaction, the cause of which had not been diagnosed.

Complications, when they did occur, were either completely hidden or sufficiently masked to distort the criteria for more extensive surgery. For this reason, therefore, following simple mastoidectomy the drug should not be given in uncomplicated cases.

In the case of lateral sinus thrombosis or petrositis, the limit of surgical measures must be reached before the drug can be safely given.

In the last 8 years an appreciable deterioration in hearing has been noticeable in the cases of otitis media passing through the outpatient department of the Edinburgh Royal Infirmary. In the absence of other factors, this must be attributed to the masking effect of the drug causing delayed drainage from the middle ear. This may promote an adhesive inflammatory change or, as suggested by Kopetzky, may be due to a hydrops of the labyrinth as the result of a chemical reaction between the perilymph behind the oval and round windows, and the purulent contents of the middle ear. Only promptness in the relief of this hydrops by drainage of the ear will save the hearing; if delayed, permanent changes may occur in the cochlea.

The author states that cases of acute otitis media are now arriving at the Outpatient Department much later than in other years. A number of the patients seen are those who have failed to be cured by the "box of white tablets and ear drops" supplied by their doctor. For this reason operative drainage has occurred as late as from 3 to 4 months after the acute attack. This has caused an increase in the number of cases which have developed chronic otitis media.

A series of 6 clinical records is submitted to illustrate the masking effect of the sulfonamides.

JOHN F. DELPH, M.D.

Youngs, N. A., and Lindsay, J. R.: Suppurative Labyrinthitis. *Ann. Otol. Rhinol.*, 1946, 55: 43.

The case presented by the authors is an example of the complicated clinical picture which may accompany a petrous pyramid suppuration, and illustrates the limitations of chemotherapy in its present form.

NOAH D. FABRICANT, M.D.

Day, K. M.: Hydrops of Labyrinth (Ménière's Disease). Diagnosis and Results of Labyrinth Surgery. *Laryngoscope*, 1946, 56: 33.

Successful results from labyrinthine surgery in 19 consecutive cases of unilateral hydrops of the labyrinth have convinced Day that this type of surgery is no longer experimental, but the best kind of treatment for this condition. Moreover, he believes that it should replace the intracranial procedure of section of the eighth nerve.

The author now feels fully justified in advising operative interference for those cases of hydrops of the labyrinth that do not respond to conservative

therapy or for patients who are losing enough time from their occupation to be considered economically handicapped.

NOAH D. FABRICANT, M.D.

### MOUTH

Steinberg, I. R., Mengoni, H. R. and Oscar Viglino, J. R.: Tuberculous Ulcer of the Tongue (*Úlcera tuberculosa de lengua*). *Prensa med. argent.*, 1946, 33: 576.

A white male, 52 years of age, had suffered an acute attack of lung trouble at the age of 16, and since then has had chronic bronchorrhea, at times quite abundant, but he had continued to work at various occupations, as farm hand, milkman, baker, and garage man. In July of last year, pains, accompanied by cough and mucopurulent expectoration, occurred in the left side of the chest and then changed over to the right side and the patient lost 10 kgm. (22 lb.) in weight. It was apparently about the time of the pain attacks that the patient noted a small firm nodule in the anterior dorsum of the tongue, somewhat to the left side, which seemed to increase in size as the chest condition became worse; at times, however, it disappeared entirely.

About 6 months later the lump ulcerated, continuing to increase in extent and depth until at the last examination the lesion was a huge, punched out, sluggish ulcer with irregular, edematous edges extending almost all the way through the tongue and terminating in a lardaceous looking irregular floor (Fig. 1).

Physical and roentgenological examination uncovered an excavating, acinoexudative pulmonary tuberculosis predominantly on the left side; the sputum was positive for tubercle bacilli; and biopsy

confirmed the tuberculous nature of the tongue lesion itself.

Rapid improvement has taken place with rest, good food, vitamins, especially B<sub>1</sub> and nicotinic acid, general tonics, topical cocaine or pantocaine before eating, and, finally, chrysotherapy.

It is thought that with the absence of all evidence of etiological trauma in this practically edentulous patient, this lingual lesion arose hematogenically as a tuberculous gumma, closely bound up with the pulmonary involvement; the tongue lesion tended to influence the pulmonary condition unfavorably, because it created difficulty in eating, and therefore the whole process constituted a true vicious circle.

JOHN W. BRENNAN, M.D.

### NECK

Mahaux, J.: Acute Hyperthyroid Crises. Physiopathological Study (*Les crises aiguës des hyperthyroïdiens. Étude physiopathologique*). *Rev. belge sc. med.*, 1945, 16: 21.

Hyperthyroidism evolves in stages, beginning with an initial traumatism in a subject constitutionally predisposed to a disease in which an abnormal amount of thyroxine is mobilized, continuing in a stage in which the neuroendocrine body mechanism becomes adapted to a metabolism at an elevated level under excessive thyroid stimulation, and terminating under this precarious thyroid balance in cardiac failure or general incapacity. In the later stages of the illness any one of many stimuli—a mild infection, fatigue, pregnancy, emotional stress, slight trauma, or interruption of iodine therapy—may precipitate a so-called thyroid crisis which is often terminal. Such a crisis, however, is most frequently seen following thyroidectomy.

The cause of the thyroid crisis is believed to be a sudden cessation of thyroid secretion. Premonitory signs include anorexia, persistent insomnia, great emotional instability, occasionally vomiting and diarrhea, pain in the thyroid gland, a rapid increase or decrease in the volume of the gland, an accentuation of exophthalmos, and intense motor agitation. Icterus, severe hyperpyrexia, and a rapid pulse also appear. The electrocardiogram discloses a slowing up of the intracardiac conduction. Cachexia develops rapidly. The iodine levels in the blood fall. If death supervenes, autopsies reveal an indurated gland, a parenchymal hyperplasia, and an almost complete absence of colloid.

In the patient with chronic hyperthyroid disease the colloid reserve is actively resorbed without having been reconstituted and is immediately dispersed in the blood. The iodine level of the gland falls, and the thyroglobulin is found to be poor in thyroxine. Normally, only a certain portion of the iodine is used to resynthesize thyroxine; the rest is excreted. One sees a negative iodine balance, an "iodine diabetes," in which the excretion of iodine is enhanced to the point of complete elimination. The treatment of chronic Basedow's disease with



Fig. 1

iodine based on the previous considerations is well established and has reduced somewhat the frequency of thyroid crisis. However, there are other factors to consider. There exists in each acinus a delicate balance between intravascular secretion and secretion into the blood, and if there is a preponderance of the latter function, the cells cannot build up reserve colloid and, at length, in spite of sufficient iodine, acute depletion occurs.

The treatment of the acute thyroid crisis has generally been the administration of large doses of iodine, but this has not proved satisfactory. Two cases are presented which ended fatally despite iodine and additional symptomatic therapy. In 1925 an acute thyroid crisis was first treated by giving thyroxine intravenously, by Kessel and Hyman, with clinical resolution of the symptoms and a return to the chronic state of mild hyperthyroidism. As far as is known to the authors, this treatment has not been put into general practice since that time, and 3 cases are presented in which thyroxine was used following the failure of iodine therapy. In a typical case, that of a crisis precipitated by a serum reaction in a case of chronic Basedow's disease, the patient was given iodine for 12 days without effect, and responded promptly and favorably to thyroxine. Contrary to popular opinion, thyroxine is not the exciting agent but acts as a stabilizing agent in an endocrine vegetative equilibrium (adapted to an elevated level of thyroid activity) which is disturbed by the acute failure of thyroid secretion.

Formerly one-third of the cases of thyroidectomy resulted in the development of an acute thyroid crisis. From 12 to 30 hours after operation agitation, an exacerbation of the exophthalmos, insomnia, temperature elevation, and cardiovascular collapse were observed. The height of the symptoms appeared 2 or 3 days after the resection, and if the patient could pass this critical period, the prognosis became better. The cause of the postoperative crisis appeared to be the sudden lack of thyroxine due to suppression of the thyroid parenchyma; an increased demand of the organism for thyroxine was met only by a greater depletion of the hormone. Many surgeons still incorrectly believe that the trauma of thyroidectomy liberates an excess of thyroxine into the general circulation and that excess thyroxine produces the symptoms. To controvert this is the observation that crises cannot be produced in a patient with hyperthyroidism by thyroxine injections. Biochemical studies have proved that thyroxine levels are low in severe post-thyroidectomy cases—this "hypothyroxemia" is responsible for the postoperative crises. This opinion is held by many authorities.

Systematic preoperative and postoperative thyroxine administration is indicated as part of the surgical treatment of hyperthyroidism. A series of 175 cases were surgically treated and 4 mgm. of thyroxine were injected immediately after operation without the appearance of a single crisis. It is important to

note that satisfactory preoperative preparation does not insure against a postoperative hypothyroxemic crisis—"the destiny of the hyperthyroid operative cases is actually obscured by a cloud of uncertainty." From 1 to 2 mgm. of thyroxine are given at the time of anesthesia, followed by the administration of from 2 to 4 mgm. of the same drug immediately after intervention, and then by from 1 to 2 mgm. every 8 hours for 3 or 4 days; this avoids the danger of a crisis. From 12 to 60 hours after the thyroxine injections have been terminated there is a transitory increase in the pulse rate but this mild hypothyroxemia should not cause concern. Eventual postoperative complications (hemorrhages, post-operative pneumonia, laryngeal difficulty), which are not to be confused with an acute crisis, occasionally appear, but they are generally not severe. It goes without saying that surgery is contraindicated in the presence of a thyroid crisis.

A resection of the cervical sympathetic chain, complete or partial, brings on an immediate exaggeration of symptoms, even a thyroid crisis. X-ray irradiation of the thyroid does not obviate the dangers of a crisis, in fact it may even bring on hypothyroxemic shock; the use of thyroxine does away with the use of irradiation.

The role of the thyrotropic hormone of the hypophysis is significant in the etiology of the thyroid crisis. Several authors are quoted who report the production of a crisis in a hyperthyroid patient by the injection of thyrotropic hormone. The administration of thyroid over a long period of time causes an increase in the stimulating activity of the pituitary gland, and, should thyroid administration be stopped (as in the course of treatment of obesity), a thyroid crisis may be precipitated due to excess thyrotropic activity. One such case is reported which ended in death. It is concluded that the hypophysis functions to maintain a constant supply of thyroid hormone; in hyperthyroid states the extent of this control is greater in maintaining greater thyroid activity. Excess thyrotropic hormone following the lowering of thyroid activity, as after thyroidectomy, plays a part in the production of a thyroid crisis; therapeutic thyroxine allows for hormonal adjustments to occur and for this reason there is a reduction of the danger of a crisis to a minimum.

It is concluded that the adequate preoperative and postoperative administration of thyroxine can prevent the sudden neuroendocrinological disbalance which is manifested by hypothyroxemia and the acute thyroid crisis. PHILIP B. CHASE, M.D.

Halpert, B., Cavanaugh, J. W., and Keltz, B. F.: Structural Changes in the Thyroid Glands of Patients Treated with Thiouracil. *Arch. Path., Chic.*, 1946, 41: 155.

Seven patients with marked signs and symptoms of exophthalmic goiter were so treated as to provide material for a study of the effects on the thyroid gland of thiouracil alone, of a strong solution of

iodine (U.S.P.) followed by thiouracil, and of thiouracil followed by a strong solution of iodine (U.S.P.). On all, bilateral subtotal thyroidectomy was performed in one or two stages. Two patients received preoperative therapy with thiouracil only; 3 were treated with a strong solution of iodine (U.S.P.) followed by thiouracil, and 2 were treated with thiouracil followed by a strong solution of iodine (U.S.P.).

In the glands removed following the administration of thiouracil only, the acinous content stained lightly and was decreased or absent and the cells lining the acini were low or tall columnar. These changes were quite similar to those seen in the thyroid glands of untreated patients in an active state of hyperthyroidism. In the patients treated with a strong solution of iodine (U.S.P.) followed by thiouracil, the thyroidectomy was performed in two stages and the former drug was used prior to the first surgical procedure and thiouracil prior to the second. Following the administration of thiouracil the cells of the acini changed from cuboidal to columnar, and the colloid disappeared or decreased in density and became vacuolated and scalloped. In the glands removed after the administration of thiouracil followed by the strong solution of iodine (U.S.P.), a refilling of the acini with colloid could be observed together with a change of the lining cells from columnar to low columnar or cuboidal.

According to these observations, the acinous colloid diminishes in quantity and density or disappears under the influence of thiouracil. The variance between structure and function of the thyroid gland following the administration of thiouracil supports the assertion that thiouracil inhibits the production of new colloid but does not interfere with the use of the available colloid.

E. A. GORVETT, M. D.

Moore, F. D.: *Toxicity of Thiouracil*. *J. Am. M. Ass.*, 1946, 130: 315.

In order to evaluate the incidence of severe toxic manifestations of thiouracil therapy, an accumulation of data on the experiences of 24 clinicians in 10

American clinics and 1 English clinic, are presented, a total of 1,091 patients are included in the material.

The clinics and number of cases were: Barnes Hospital and Washington University School of Medicine, 62; Beth Israel Hospital, 63; Boston City Hospital and Massachusetts Memorial Hospitals, 225; Jefferson Medical College and Hospital, 55; Johns Hopkins Hospital, 45; Lahey Clinic, 196; Massachusetts General Hospital, 99; Mayo Clinic, 38; New York Hospital, 125; Presbyterian Hospital, 88; University College Hospital Medical School (London), 64; University of California Medical School, 31.

Treatment was given for a period ranging from 2 weeks to 2½ years (in the majority of cases for from 2 to 8 months), with a dosage of from 0.5 to 0.8 gm. per day for from 3 to 7 weeks, or until the basal metabolic rate was normal, after which the dosage was reduced or the patient was operated on.

The hematological changes were stressed, rather than the tabulation of all the symptoms, as the leucocyte changes were considered most serious.

The most important data were: the incidence of total deaths, 0.7 per cent of 1,091 cases; the deaths due to drugs, 0.5 per cent of 1,091 cases; agranulocytosis, 1.7 per cent of 1,091 cases; the deaths from agranulocytosis, 26 per cent of 1,091 cases; leucopenia, 3.4 per cent of 781 cases; gland enlargement, 2 per cent (the author gives 5 per cent but cites 10 among 458 cases); drug fever, 5 per cent of 781 cases; and miscellaneous reactions, 2 per cent of presumably 1,090 cases.

A table is given of the details of the 19 cases of agranulocytosis. The 2 per cent of miscellaneous reactions are briefly described and discussed.

The total incidence of severe reactions which necessitated the stopping of treatment with thiouracil was between 8 and 10 per cent.

The most dangerous period, from the viewpoint of leucopenia, was between the fourth and eighth weeks from the start of treatment, although it may be earlier if the drug has been given previously, regardless of whether or not there were untoward reactions at that time.

CLINTON H. THOMAS, M. D.

# SURGERY OF THE NERVOUS SYSTEM

## PERIPHERAL NERVES

Albritten, F. F., Jr., and Maltby, G. L.: Causalgia Secondary to Injury of the Major Peripheral Nerves. *Surgery*, 1946, 19: 407.

Causalgia of the type described by Weir Mitchell has been seen in a considerable number of cases (67) seen at Ashford General Hospital, White Sulphur Springs, West Virginia, during a twelve month period. The lower extremity was involved in 44 cases, and the upper extremity in 23. The seat of maximum pain has been in the posterior tibial and median nerves in all instances.

The treatment given was to first block the sympathetic fibers by procaine block of the sympathetic ganglia, and if this afforded marked relief to proceed to a sympathectomy. On rare occasions patients received permanent relief from a single sympathetic block. Both the muscle splitting extraperitoneal approach for the removal of the second and third lumbar ganglia, and the thoracolumbar operation described by Smithwick have been used. The Smithwick procedure has been used for sympathectomization of the upper extremity. These procedures were carried out in 30 cases—22 with involvement of the lower extremity and 8 with involvement of the upper extremity. Results were good to excellent in 28 cases; 2 patients showed no relief despite technically satisfactory sympathectomies.

The authors believe that the procedure should be of sufficient extent to include the area of injury as well as the area of symptoms and that early sympathectomy will, in the vast majority of cases, relieve the symptoms of disease and prevent the profound disabilities of disuse.

JOHN W. EPTON, M.D.

## BRAIN AND ITS COVERINGS; CRANIAL NERVES

Fleminger, J. J., and Smith, M. G.: Acalasia of the Esophagus following Depressed Fracture of the Base of the Skull. *Lancet*, Lond., 1946, 1: 381.

A 16 year old girl developed a total inability to swallow liquids or solids following a head injury in which there was a comminuted depressed fracture with a subdural hematoma in the right occipital region. At operation, depressed bone was removed from the right cerebellar fossa together with about a third of the foramen magnum, which was involved along with the right hypoglossal canal in the fracture.

Two months after operation an attempt was made to induce normal swallowing by suggestion with the patient under intravenous sodium amylal anesthesia. This was unsuccessful. Two and one-half months after surgery, x-ray examination showed the meal to be held up both at the upper and lower ends of the esophagus, indicating an achalasia of the cricopharyngeus and of the cardiac end of the esophagus.

For that reason it was decided to attempt the relaxation of these muscles with amyl nitrite. She was given an ampoule of this drug to inhale. In a very few minutes she was able to swallow a small amount of liquids and solids. Thereafter, she showed an increasing ability to masticate more normally.

The authors conclude that this patient represented a striking example of combined somatic and psychological disorder. A vicious circle initiated by physical damage, and largely perpetuated by emotional disturbance, was eventually broken, with complete restoration of function.

JOHN W. EPTON, M.D.

Devic, A., Ricard, A., and Guinet, J.: Delayed Post-Traumatic Brain Abscess (Les abcès du cerveau post-traumatiques tardifs). *Lyon chir.*, 1945, 40: 463.

A syndrome is described which is a localized brain abscess occurring years after injury, and generally long after the patient appears to have made a complete recovery. Two personal cases are presented in detail along with a brief review of the literature.

Pathologically, the abscess is usually multilocular and surrounded by a very thick capsule. Because of the heavy capsule the surrounding structures are damaged only by compression and not by spread of the inflammatory process.

The etiology is attributed to organisms brought into the brain substance on bone spicules or metal fragments at the time of the original wound. These organisms are believed to remain alive but latent for months or years in the midst of a small mass of scar tissue. Clinically there are three distinct phases: the acute injury, the more or less asymptomatic latent period, and the phase of suppuration. In the last phase there are no signs of general infection and the evidence of increased intracranial pressure is not constant. The most characteristic symptom is progressively severe localized headache. Subsequently, insomnia, vomiting, and stiffness of the neck may appear. Slowing of the pulse is rather characteristic. Other manifestations depend on the size and location of the abscess, e.g., epileptic convulsions, paralysis and sensory disturbances.

The prognosis with operation is favorable—usually recovery with a minimal localized residue. Without surgery the outcome is always fatal. For prophylaxis the use of sulfa drugs and more thorough débridement are suggested. Once an abscess has developed, excision of the whole mass is advised in preference to drainage because of the dense capsule which is usually present.

THEODORE B. MASSELL, M.D.

Scott, M.: Nontraumatic Hematomas. *J. Am. M. Ass.*, 1946, 130: 845.

The author reports the results obtained in the surgical evacuation of spontaneous nontraumatic



hematomas of the left temporal lobe. The patients presented the following symptoms:

1. Sudden onset with severe headache in 2 cases, and aphasia in the third case.

2. Progressive drowsiness.

3. Focal symptoms of an expanding lesion in the left temporal lobe, viz., partial aphasia with anomia and jargon speech; right homonymous hemianopsia; increased deep tendon reflexes on the right; Hoffmann and Babinski signs on the right; progressive weakness of the right side of the body; no sensory disturbances; and shift of the pineal gland to the right.

4. The spinal fluid pressure was usually increased; the fluid blood was tinged, clear, or xanthochromic, with the total protein above normal.

Following a left exploratory craniotomy, a subcortical hematoma was found in all 3 cases in the left posterior superior temporal lobe. The clot was removed by suction, the dura closed, and the bone flap replaced. Recovery with improvement occurred in all 3 cases.

Any person, regardless of age, developing sudden headache associated with progressive focal signs such as aphasia, hemiplegia, anesthetics, or visual field defects, vomiting, and progressive drowsiness should be considered to have a space-taking lesion, possibly intracerebral hematoma. Exploratory craniotomy with evacuation of the blood clot offers the best method of treatment in cases showing progression in signs and intracranial pressure.

JOHN W. ERTON, M.D.

Tom, M. I.: Metastatic Tumors of the Brain. *Canad. M. Ass. J.*, 1946, 54: 265.

In a series of 82 cases of metastatic tumor of the brain (no patients with metastases to the dura, skull, spinal cord, or nerves were included), 18 patients, 15 male and 3 female, had their primary tumor in the lungs, 13 (all female) had their primary tumor in the breast, and 9 patients, in the bowel, while in 7 patients the tumors arose from malignant melanomas.

The various other endocrine glands and the common sites of tumor in the genitourinary tract of both sexes revealed a surprisingly small number of tumors metastatic to the brain. Metastases were found in the cerebral hemispheres of 40 patients, in the cerebellum of 23 patients, in the pituitary gland of 19 patients, and in the subarachnoid spaces of 14 patients. Multiple metastases occurred in 41 cases, and single metastases in 41 cases. The primary symptoms in the breast were almost always recognized before the symptoms of cerebral metastasis were observed, but the reverse was true in the case of lung tumors.

Of 52 cases in which complete autopsy was performed, 78.9 per cent were found to have either primary or metastatic tumors in the lungs. This high incidence of tumor in the lungs, either as the primary site or locus of metastasis, should impress upon us the necessity for thorough physical and x-ray examination of the chest whenever there is a question of differentiation of primary from secondary tumors of the brain.

JOHN MARTIN, M.D.

Ectors, L.: Mechanical Results of the Development of a Tumor in the Craniovertebral Cavity (Les conséquences mécaniques du développement d'un tumeur dans la cavité craniovertébrale). *Re. d'ot.*, Par., 1945, 64: 204.

In a study of the mechanical results of tumor development in the craniovertebral cavity, the author demonstrates the effects of pressure and space limitation on the various tissues of the cranial cavity individually and as a whole. Schematic drawings illustrate a discussion of the effects of compression on nerve tissue, veins, and the cerebrospinal fluid, and the results of displacement of the brain stem. Compression of nerve tissue beneath the tumor produces a focal syndrome which is followed by the characteristic symptoms of displacement and, finally, by signs of cerebral or cerebellar hernia with peduncular or bulbar involvement and death. Some tumors of the brain stem may present a purely focal syndrome to the end. Both reversible and irreversible lesions may be produced by compression of the nerve tissue.

Early postoperative improvement is due to removal of the tumor and the secondary more protracted improvement to subsidence of the vascular disturbances and edema. The deficiency left after maximum improvement has been attributed to attributable to irreversible lesions. Histological studies confirm such a course.

Extracerebral tumors cause more marked lateral displacement of the brain than intracerebral tumors. Only tumors of the frontal third produce homolateral hemiplegia by displacement of the brain stem because the frontal third projected on the orifice of the falx cerebri is thus connected with both halves of the cranial cavity. The mechanism responsible for homolateral pyramidal signs in acoustic neuromas is likewise explained.

Pressure on intracranial blood vessels may produce symptoms masking the focal effect on the nerve tissue. Reports on the effects of compression on the arteries in the cranial cavity are scarce and contradictory. Venous compression produces edema, which if limited to a small portion of the brain may cause no symptoms. Involvement of nearly an entire hemisphere is necessary to produce symptoms. Venous compression also leads to the formation of a transudate rich in proteins, with resulting marked increase in the protein content of the cerebrospinal fluid below the level of the tumor without any increase in cellular elements, the well known protein cellular dissociation syndrome.

Even greater disturbance is caused by pressure in the cavities containing the cerebrospinal fluid, and the effects are entirely different, according to whether the pressure is increased in the ependymal or subarachnoid circulation of the cerebrospinal fluid. The ependyma is impermeable to the fluid and the pia mater, permeable. The effects of various ventricular tumors on the pressure conditions and dilatation of the ventricles are discussed. Tumors of the subarachnoid system have an entirely opposite effect, producing edema. Thus pressure at different sites

may lead to diametrically different symptoms, namely, to hydrocephalus or edema, with not infrequently a conflict between the two. Illustrative cases are cited. The extracranial portions of the optic nerve react to pressure in the subarachnoid system, but not to intraventricular pressure because the ventricles are separated from the nerve by a bony wall. The effect of glaucoma in relieving choked disc is analogous to that of hydrocephalus on edema.

Intracranial spatial deficiency due to tumor development depends not only upon the size of the tumor but upon the degree of edema or hydrocephalus produced by the tumor. Small tumors in the aqueduct of Sylvius may cause marked early spatial deficiency, while large interhemispheric tumors of the anterior third may not produce symptoms of spatial deficiency until late in their course.

The tendency of tumors of the anterior part of the brain or the midbrain to push the brain through the tentorial orifice into the posterior cavity, and of posterior tumors to crowd the cerebellum through this orifice into the median cavity and through the occipital fossa into the spinal cavity, is discussed. Supratentorial tumors producing edema and not hydrocephalus will force the temporal lobe through the tentorial orifice which results in herniation. Compression of the veins in the neck of such hernias causes edema of the herniated portion. Tumors producing hydrocephalus without edema do not cause herniation. Cerebellar hernia produced by a similar mechanism will compress the cerebral peduncle which leads to venous congestion and frequently results in hemorrhage. Involvement of the cerebral tonsils produces the syndrome of bulbar compression.

Any measure that reduces edema will relieve symptoms, and the intravenous injection of a hypertonic solution has a marked temporary sedative effect. On the other hand, horizontal decubitus which increases intracranial venous pressure, or an enema causing prolonged congestion of the abdominal veins, will cause exacerbation of the symptoms; cough, sneezing, defecation, or emotional excitement will do this also. Any measure which diminishes the pressure in the cavity subjacent to the lesion favors herniation, as illustrated by the disastrous and frequently fatal results of spinal puncture with its aspirating effect.

EDITH SCHANCHE MOORE.

**Dickmann, G. H.: Cerebral Resections (Resecciones cerebrales). Rev. As. med. argent., 1946, 60: 91.**

The author discusses the indications for cerebral resection, and reports 8 cases which were operated upon, 3 having been reported previously. Only 2 case reports of lobectomy for traumatic epilepsy are given; gross cicatricial lesions of the frontal lobe were found in both of these cases. A special report on the results of surgical treatment of epileptics will be published later.

Four conditions are cited in which the operation may be indicated:

The first one is cerebral tumor or inflammatory process. Here the operative mortality in competent

hands does not surpass 15 per cent, and even though definitive cure cannot always be promised, the amelioration is always greater than that obtained by simple decompression. A clinical cure of from 7 to 8 years, even in malignant tumors, amply justifies the procedure. Although tuberculomas may often be enucleated easily, the operation of intracapsular enucleation promises nothing more than a recurrence of the tuberculoma or tuberculous meningitis, since the capsule always contains tubercles in abundance.

The second condition is that in which the brain substance must be resected in order to reach more deeply seated lesions, such as tumors of the lateral ventricles or of the third ventricle, in which partial resection of a cerebellar lobe is necessary to reach the cerebellopontine angle, or in which removal of a frontal lobe is necessary to attain the region of the hypophysis, in the presence of craniopharyngiomas, or olfactory or parasellar meningiomas, or removal of the temporal or occipital lobes is necessary for deep lesions.

The third condition cited is that of traumatic epilepsy, in which the author, guided by his electric excitator (thyatron), attempts to excise all the scar tissue and even opens up the ventricles to do so. In 1 of the 2 epileptics here reported all the scar tissue could not be removed because of the contiguity of the prerolandic area and this case was the only clinical failure in the entire group. The author rather discounts the influence exerted by shallow, superficial meningoencephalic traumas.

The fourth condition is that of deep hemorrhage which cannot otherwise be exposed and controlled.

The first case history was that of a 32 year old male with convulsive attacks, whose failing vision suggested something more than a jacksonian epilepsy, and at operation an astroblastoma of the right frontal lobe was uncovered. Here an extensive resection of the involved lobe removed most of the tumor. Since the operation he has suffered an occasional attack of convulsions, which were largely controlled by luminal. Case 2 was that of a 37 year old female who was operated upon twice. At the first operation a flat, mushroom tumor, attached by a pedicle rather far forward on the cortex of the frontal lobe, was removed and the area was quite intensively irradiated; nevertheless, about 2 years later there was a return of symptoms (cephalgia, paresis of the rectus externus muscle of the right eye, and paresthesia) and the second operation disclosed a deep multiple cystic isomorphic glioblastoma. A resection according to the technique of Dandy removed most of the neoplasm with almost immediate relief of the paresthesia and other subjective manifestations. The patient has a clear mind and walks perfectly.

The third patient was a 25 year old male railroad worker, who began to suffer from headaches 3 years ago and eventually developed a right homonymous hemianopsia. Operation disclosed what was evidently a tumor of the left occipital lobe, which was resected with care not to disturb the optic radiations.

In the depths of this lobe a firm enucleable tumor which proved to be a tuberculoma was uncovered. The patient has since been able to continue working, but the hemianopsia has remained stationary. The fourth resection here reported was that of a 26 year old female complaining of frontoparietal cephalalgia on the left side with serious diminution of vision in the left eye growing progressively worse. Operation disclosed enlargement and tenseness of the right frontal lobe. A Dandy resection of this lobe cut through the anterior end of a firm tumor; this was then enucleated, and apparently the ventricle was opened. However, the leak of ventricular fluid ceased gradually, the wound healed, and subsequently the hemiparesis of the left leg and arm, and even the vision in the left eye improved noticeably, the patient being up and about with absolutely normal psyche a month or so later. The tumor was diagnosed as a mixed gigantocellular glioblastoma and astroblastoma. The fifth case was that of a 27 year old female complaining of headaches, diminution of vision, photophobia, vomiting preceded by nausea, and some change of psyche. Right frontal lobectomy did not entirely remove the tumor, some tissue of which was seen to extend backward out of reach. Eight months later the patient was perfectly well, the eye grounds had returned to normal, and she was able to lead her normal life. The sixth and seventh patients were those with the traumatic epilepsies already mentioned; in 1 the condition was considerably ameliorated but in the other it did not improve. The seventh patient was briefly mentioned as having undergone a left occipital lobectomy for glioblastoma; at the present time he is perfectly well and able to carry on his avocation as a roving peddler. He has gained 20 pounds in weight, and the edema of his eyes has cleared up, leaving a certain amount of postdematous optic atrophy.

The author is not as much interested in the striking recovery following lobectomy with regard to the improved vision and disappearance of pareses, which may be ascribed to pressure and would tend to get better following its removal, as he is in the changes in the higher psychic functions to be expected from removal of so much of the important tissues of the brain, such especially as those represented by the frontal lobe of the cerebrum. When one tries to analyze the individual functions of a higher nature, there do not seem to be any appreciable changes in the lobectomized patient aside perhaps from a certain appreciable disproportion, a failure to exhibit the justifiable anxieties of the situation, and an absolute lack of preoccupation with the future. The emotional status seems to return to its former level; some patients are less irritable and more tolerant, and an adequate response to humorous situations is noted.

However, when the examiner ceases to scan the psychic qualities, such as intelligence, memory, attention, and moral and esthetic senses individually, and turns his attention to that something which causes each individual to differ from all others, he will note that the frontal resection has produced a

modification of the personality, which may escape the analysis of one not experienced in the problems of psychiatry and psychology. These alterations consist in an evident limitation of the complexities of thought. It is difficult to incite these patients to new activities, requiring more elaborate mental functioning. There is a relaxation in the will power, a difficulty in synthesizing thoughts and sentiments, and also in comprehending at a single glance a variety of representations, a certain amount of apathy, a fault in planning initiative, and a diminution in the power of imagination. However these individuals do not suffer disturbances of sphincter control nor alterations in the tone of the superficial or deep reflexes.

The author does not share the localization ideas of Kleist, because it was always possible that the lesion extended beyond the limits of the frontal lobe in the war casualties which he observed.

The author believes that frontal lobectomy has revealed the following facts:

1. Either of the frontal lobes is capable of carrying on satisfactorily the normal functions of both;
2. There is no predominance of function in either of the frontal lobes. A patient who has undergone a resection of the left frontal lobe is the same as one who has lost the right lobe.
3. The frontal lobe syndrome, characterized by defects of intelligence and alteration of the personality, is not the consequence of the suppression of the lobe, but of its dysfunction.

JOHN W. BRENNAN, M.D.

### SPINAL CORD AND ITS COVERINGS

Elkins, C. W., and Wegner, W. R.: Newer Concepts in the Treatment of the Paralyzed Patient Due to Wartime Injuries of the Spine—Neurosurgical Complications. *Ann. Surg.*, 1946, 123: 516.

From their experience with spinal cord injuries, the authors found that the most frequent neurosurgical complications are the result of retained foreign bodies in close proximity to the spinal cord or peripheral nerve roots, intractable pain, and uncontrolled spinal reflexes.

Retained foreign bodies were found in 16 per cent of the cases. Their location within the spinal cord, or in or close to the cauda equina, the presence of intractable pain, or of a persistent draining sinus, determined the indications for operation. The removal of the foreign bodies, however, did not improve function but relieved the pain when pain was present, and the draining sinuses healed.

Pain is an old problem in paralyzed patients and contributes, by its persistency, to the patients' debility. The character of the pain differed from a root type to generalized burning, aching, or a pulling sensation, usually in an extremity but occasionally in the bladder and the rectum. Scar tissue was thought to be one of its causes, but was too extensive to be removed. The authors performed a spinotomic cordotomy in 3 cases and obtained good

results. They noticed a marked improvement in the general nutrition of these patients after operation.

Uncontrolled spinal reflexes are present in a large percentage of paralyzed patients following spinal cord injuries and they present a very difficult therapeutic problem. They are described as simple flexion, extension, crossed extension, extensor thrust, reflex stepping, and mass reflex. No reflex characteristics typical of the level or degree of severity of the cord lesion could be found.

The authors point to the fact that many of these patients may have multiple and widespread lesions or discontinuous areas of hematomyelia causing confusion in the reflex pattern. From their observation, the extensor reflexes were generally found in anatomically incomplete lesions, and were frequently accompanied by clonus. They warn against performing destructive operations in such cases as they would permanently preclude the possibility of a spontaneous recovery of function. They advise a conservative course of treatment such as splinting, traction, and physiotherapy. They gave curare to some of their patients and found it useful only as an adjunct to other therapy.

For the patients in whom conservative measures did not help, more radical therapy was often helpful. Division of the anterior and posterior branches of the obturator nerves has relieved adductor spasms in paralyzing the principal adductor muscles, but because of the fibrotic changes which have occurred in the muscles and around the hip joints the authors recommend the application, for several months, of adduction splints immediately after the obturator nerve sections.

In patients with severe flexor and extensor spasms and a verified complete spinal cord lesion, anterior rhizotomy of the appropriate nerve roots became the procedure of choice. These patients may also require tenotomies for the release of fixed contractures around the joints. The authors report satisfactory results in 3 cases following anterior rhizotomy.

GEORGE PERRET, M.D.

Munro, D.: The Rehabilitation of Patients Totally Paralyzed Below the Waist, with Special Reference to Making Them Ambulatory and Capable of Earning Their Own Living. *Urination*. *N. England J. M.*, 1946, 234: 207.

The control of urination in paralyzed persons is a major social necessity and anything short of complete control becomes a source of mental misgivings and economic loss. To be unable to walk, or to walk well, is one thing, but to continually smell of urine and to be unable to spend a night away from home is another. This state of affairs may result from any serious injury or maldevelopment of the spinal cord unless the bladder is taken under immediate and rigorous control. This article is a very forcible discussion of the value of tidal drainage with its resultant "infallible 24 hour control of urination."

The cases studied included 125 selected from among 243 patients with injuries to the spinal cord

and, in addition, 24 in which tidal drainage was either not needed or not used. The treatment, if any, in these 24 cases studied for comparison is not mentioned. However, all but 1 of 101 patients were treated by tidal drainage and were taught to control their bladders so that they have "infallible 24 hour control of urination."

The treatment consists of the immediate placement in the bladder of a No. 16 or 18 Fr. soft rubber rectal tube, held in place with adhesive tape. For the last 6 years no urinary antiseptics have been administered by mouth but the bladder has been irrigated frequently with buffered citric acid solutions. The catheter is changed once a week and the fluid intake is kept at 4,500 c.c. per day. As soon as the bladder becomes active at a reflex level, training is begun so that in the end the patient need only pass urine every 3 hours or more and is able to go through the entire night without wetting the bed. Tidal drainage with an inbuilt apparatus for measuring the bladder pressure is necessary to satisfactorily carry out this program. No other method can accomplish these results.

Various complications are common with any method of controlling the bladder, but they are much less conspicuous in tidal drainage methods. Urethral complications may be avoided if nothing larger than a No. 16 or 18 Fr. catheter is used. Urinary infection is least with tidal drainage. These statements are supported by statistical tables.

Other methods of controlling the bladder are mentioned only to be condemned as inferior. Suprapubic drainage is to be used only under extraordinary conditions and should rarely, if ever, be necessary in civil practice. The methods are intermittent irrigation, penile clamp, suprapubic cystostomy, perineal urethrostomy, and rubber urinals. The reasons why these procedures are ineffectual are clearly and forcefully laid down.

ADRIEN VERBRUGGEN, M.D.

## SYMPATHETIC NERVES

Nocito, F. J., and Nocito, C.: Surgery for the Relief of Pain. Anterolateral Chordotomy (*Cirugía del dolor. La cordotomía anterolateral*). *Prensa med. argent.*, 1946, 33: 285

The author reports 36 cases in which anterolateral chordotomy was performed with good results and he draws the following conclusions from his observations:

Two types of pain can be distinguished; peripheral or somatic, and visceral or splanchnic. Both types coexist only in the region of the external orifices, while in other parts of the body the sympathetic system does not participate in the production of somatic pain, and splanchnic pain is independent of the cerebrospinal system. Because of the synergism between the somatic, superficial pain and thermotactile functions, the stimuli responsible for painful sensation can be located and identified, while a deep pain can be located but the stimuli cannot be recognized. Factors responsible for the splanchnic

pain may be of a chemical, inflammatory, or ischemic nature. Polyradicular innervation is responsible for the fact that pain originating in the viscera cannot be located exactly.

The author discusses the anatomic paths of the conduction of pain and shows that anterolateral chordotomy is theoretically justified. He cites the following indications for the operation:

1. Locomotor ataxia, especially if one of the three conditions—visceral crises, so called topalgia or pains in the distal portion of the extremities, or pain caused by radiculitis of the cauda equina—is found to be present.

2. Cancer. Cachectic patients should not be operated on. Chordotomy is indicated particularly in the presence of a cancer of the female genital organs, prostatic gland, bladder, or pleural endothelioma, and in the presence of primary or secondary cancer of the spine. Suppression of pain without resort to the use of morphine facilitates proper nutrition and improves the general condition of the patient.

3. Other indications, such as ascending neuritis if a sympathetic gangliectomy had failed; plexitis or funiculitis due to a lesion of the spinal cord; painful amputation stump; Charcot's painful paraplegia; kraurosis vulvae; certain cases of painful fractures of the pelvis; chronic spondylitis; and deforming arthritis of the hip.

Only patients in a good general condition are suitable for the operation. Those weakened by chronic morphine poisoning should be built up with liver injections and blood transfusions. Hypotension requires attention because chordotomy favors syncope. Special attention should be paid to the condition of

the lungs, myocardium, and urinary tract before the operation is attempted.

Among the postoperative complications, retention of the urine is frequent and requires periodic catheterization. The normal vesical reflex is usually re-established on the fifth or sixth postoperative day. Trophic disturbances may be responsible for a disruption of the wound or the formation of decubital ulcers. Disruption of the wound occurs with relatively great frequency in patients with locomotor ataxia or hypoproteinemia. Many patients complain of radicular pains during the first few postoperative days. The pathogenesis of this complication is obscure. Possibly the pains are caused by an irritation of the posterior roots or an injury of the spinal cord during the operation. Motor disturbances also occur and may be ascribed to an irritation or a more serious injury to the pyramidal tract. A transitory or permanent paralysis may result.

In the authors' material only 1 case of transient paralysis was recorded.

The mortality in the authors' cases was 19.4 per cent.

As a rule, deep sensations are preserved after operation, but thermic sensations are abolished after a spinothalamic section.

In the authors' material failures were recorded in only 2 patients, or 5.5 per cent.

To combat visceral crises in tabetic patients, chordotomy is preferable to the interruption of intercostal nerves, operations on the solar plexus, posterior radicotomy, extirpation of the semilunar ganglion, or bilateral subdiaphragmatic vagotomy.

JOSEPH K. NARAT, M.D.

# SURGERY OF THE THORAX

## CHEST WALL AND BREAST

Martin, J. F., and Gulchard, A.: The Skeletogenous Tumors of the Mammary Gland (Les tumeurs squelettogènes du sein). *Lyon Chir.*, 1945, 40: 325.

Osteochondrogenous tumors of the breast are extremely rare, only 60 cases being on record in the entire literature. They are polymorphic, containing hyaline or calcified cartilage, osteoid or osseous tissue, either in rudimentary lamellas, or true bone with haversian canals and a medullary cavity. Myeloplaxes and osteoblasts are found either in the center of these bony structures or apart from them by themselves. These cartilaginous and bony elements are surrounded and held together by various kinds of connective tissue. According to the prevalence of one or the other of these tissues, the tumors are also called fibromas, myxomas, osteomas, or chondromas of the breast; however, they rarely show any systematization; but rather they are polymorphous connective tissue tumors, partly ossified or cartilaginous.

Thirty-four of the known 60 cases presented pure isolated skeletogenous tumors of the breast, 10 of these being benign osteochondromas and 24 (70%) being malignant osteochondrosarcomas. Twenty-six of the 60 cases presented mixed tumors of epithelial and mesodermal origin, fibromas or adenofibromas mixed with bony and cartilaginous elements. For the greatest part, these mixed neoplasms were malignant, giving the picture of skeletogenous epitheliomasarcoma, others resembled carcinomas with zones of ossification.

Although 75 per cent of these tumors showed the histological traits of malignancy, the clinical course was comparatively benign. Their growth was very

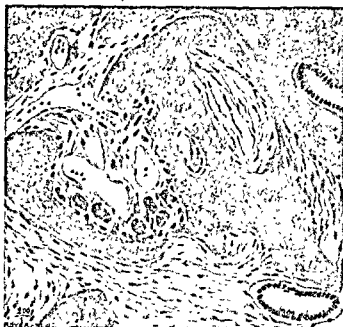


Fig. 2. Ossified adenofibroma of the breast with the aspect of a partial liposarcoma. The metaplastic ossification of the adenofibroma is shown.

slow; they did not infiltrate into the surrounding tissue, and they may exist for many years without causing metastases. Only 20 per cent of the known cases showed metastases in other organs.

As to the histogenesis, the authors consider these tumors as cases of metaplasia from the epithelial to the connective and osteogenous tissue. In their mixture of epithelial and mesodermal elements, some of these neoplasms, the epitheliomasarcomas, remind one of the mixed tumors of the salivary glands. Extremely rare in the human being, these osteochon-

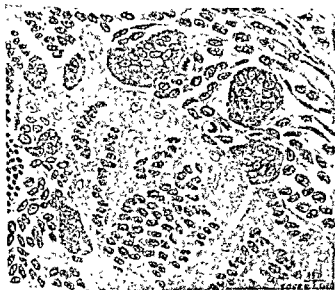


Fig. 1. Osteosarcoma of the breast.

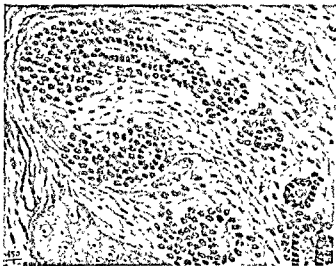


Fig. 3. Skeletogenous epitheliomasarcoma of the breast.

drogenous tumors of the mammary gland are frequent in animals, especially in the dog and cat.

The 60 cases included 9 cases observed by the authors, which were not published previously.

WERNER M. SOLMITZ, M.D.

Faugère, G. and Prat-Rousseau, C.: Resection of the Axillary Vein in the Radical Operation of Cancer of the Mammary Gland. (*Réssection de la veine axillaire au cours de l'opération radicale du cancer du sein*). *Bordeaux chir.*, 1942, 3: 131.

In cancer of the breast, the radical removal of all the lymph nodes in the axilla is a condition *sine qua non* to secure a lasting cure. One group of these lymph nodes, the subclavicular, is situated close to the axillary vein and, in cases of carcinoma, often adherent to it. For this reason, ligation and resection of the vein has been suggested by several writers. This procedure is advisable especially when carcinomatous nodes are found in the immediate vicinity of the vein. Histological examination has revealed invasion of carcinomatous cells in the adventitia of the vein.

The authors report 4 cases in which the axillary vein was resected because of adherent lymph nodes. Except for edema of the hand and arm during the first few months after the operation, no untoward sequelae were observed.

There is no doubt that the danger of metastases is reduced by the resection of the vein. However, 2 complications should be mentioned which may occur after the resection: pulmonary embolism and severe edema of the hand and arm. Neither of these complications was observed in the cases of the authors. The edema in these cases was not more severe than in many cases of the classical operation without resection. Apparently, the collateral circulation is sufficient to prevent severe edema, and it seems that the development of elephantiasis is caused by lymphangitis and following occlusion of the lymphatics by fibrosis, rather than by obstruction of the venous circulation.

WERNER M. SOLMITZ, M.D.

Brown A.: Late Recurrences in the Skin following Radical Amputation of the Breast for Carcinoma. *Q. Bull. Northwest. M. School*, 1946, 20: 18.

Evidence that a tumor recurring in the skin after an operation for radical removal of the breast for carcinoma is a recurrence in the skin itself and not a generalized chest wall metastasis, falls into two categories.

1. The tumor should involve only the skin itself but may spread into a small amount of subcutaneous tissue. Any involvement of the deeper tissues, such as deep fascia or the tissues of the chest wall, throws doubt upon the origin in the skin as the skin involvement may be secondary to a deeper origin.

2. The tumor should be histologically not only a type of tumor that does not primarily occur in the skin but also a type that occurs in the breast and closely approximates the original tumor for which the primary operation was performed. However, in

the 3 cases presented it was histologically more malignant.

Little has been written concerning skin metastases and no differentiation has been made between true skin metastasis and that occurring in the deeper tissues of the chest wall. It is the authors' belief that the important part of the operation so far as skin recurrence is concerned is the careful undercutting of the skin to the limits of deep removal. It is not difficult to go too deeply into the subcutaneous tissue and leave a small particle of breast attached to the skin. If this is done it is not possible to state that the recurrence is in the skin since it may be from the small portion of breast left in the wound.

Three case reports are presented illustrating late occurrence of skin metastasis in patients who had undergone a radical resection of the breast for carcinoma. The skin metastasis occurred as follows: 10 years and 5 months, 11 years and 6 months, and 4 years and 4 months after the primary operation. The same technique was followed in each of the cases and an outline of the operative steps is reviewed.

The interesting points found in the review of the cases presented were:

1. None of the tumors was situated in the scar of the primary operation, which remained soft and flexible throughout its entire extent and was not at any point adherent to the chest wall. In each case the tumor was situated on the outer side of the scar, apparently at the site of a previous stitch hole, and did not spread from there toward the scar. In addition to the causes of local recurrence after radical mastectomy presented in the literature, such as (1) direct invasion from the adjacent primary tumor, (2) lymphatic emboli, (3) lymphatic permeation, and (4) emboli from the blood stream, one must also consider implantation of the tumor cells into the skin at the primary operation.

2. The time interval between the primary operation and the appearance of the skin involvement was quite long. The tumor, appearing in the skin itself and a small amount of subadjacent connective tissue was in all 3 cases a type of tumor that does not occur in the skin as a primary tumor.

3. In all cases the nodule in the skin was more cellular than the original growth which in each case contained large amounts of connective tissue and therefore presented the characteristics of scirrhous carcinoma.

JOHN E. KARABIN, M.D.

### TRACHEA, LUNGS, AND PLEURA

Burke, J., and Jacobs, T. T.: Penetrating Wounds of the Chest. *Ann. Surg.*, 1946, 123: 363.

A total of 402 patients with penetrating or perforating wounds of the chest were treated in a General Hospital during the campaign in Italy, from November, 1943 to September, 1944, and in Eastern France, from November, 1944 to February, 1945. It is the purpose of this paper to discuss the problems encountered, together with such conclusions as can be drawn from the observations. During the same

period of time an equally large number of patients with chest wall injuries, pulmonary contusions, and blast injuries of the lung had been treated. Many of these have had associated hemothorax, but have not been included in this study because the wounds had not penetrated the pleural cavity. Final end results cannot be discussed at this time for several reasons. The expression "returned to duty" cannot be accepted as an end result until it can be shown that such patient remained at full duty, or even limited duty.

The patients were received for the most part from Evacuation or Field hospitals. A few were admitted directly following accidents occurring in the vicinity; and another group was admitted from the Front without preliminary treatment in Forward hospitals. This occurred during the early days of the Anzio and Southern France invasions.

It was possible to follow with considerable interest the transition in Forward chest surgery with its increasing emphasis on conservatism. Certainly, patients are being received at present with pulmonary injuries and retained foreign bodies who would have been treated by formal thoracotomy at Forward installations a year ago. This conservatism is more than adequately justified by results. The authors were favorably impressed by the condition on arrival of patients who have had no more elaborate treatment than débridement and aspiration, or débridement and closure of sucking wounds. Many of these patients required no further formal intrapleural surgical treatment. Definitive chest surgery is best carried out at the nearest hospital, where an uninterrupted convalescence can be expected. The importance of minimal delay in travel is shown in detail in the discussion.

Hemothorax is by far the commonest single complication of penetrating wounds of the chest; it occurred in 78.5 per cent of the total number of cases studied.

Small, asymptomatic hemothoraces almost always will disappear in a short time if early ambulatory activity is encouraged. If a hemothorax is small and complicated by fever, dyspnea, or pain in the chest, aspiration is carried out for both diagnostic and therapeutic reasons. Many times pain can be relieved by the removal of a small amount of blood.

The large hemothorax must be aspirated early and frequently in order to obtain satisfactory results. The prime purpose of aspiration is to obliterate abnormal pleural space and allow the lung to re-expand. This is essential if the pulmonary dynamics are to be restored to normal.

The Baxter transfusion vacuum bottle and valve are used for aspiration. We have found the use of this apparatus to be a simple, air-tight and sterile method for the removal of chest fluid. It allows the removal of 600 c.c. of blood or air at one time, and the rate of removal can be easily adjusted by the use of the valve.

The removal of 600 c.c. at one time has been practiced. Aspiration of larger quantities results in

untoward symptoms such as cough, pain in the chest, and a feeling of faintness. When these symptoms appeared, aspiration was discontinued immediately.

The injection of air into the pleural space following thoracentesis was not used in any of the cases. The authors do not share the opinion that air replacement will prevent further bleeding from the expanded lung. That bleeding recurs after aspiration is conjecture and is not validated by proof. The opposite has been found to be true by studying the hematocrit, hemoglobin, and plasma protein of hemothorax fluid. A sample of the aspirated fluid was studied by the Van Slyke copper sulfate method after each aspiration and it was found that in no instance was there evidence of increased bleeding. In fact, in all patients aspirated more than once, there was a definite progressive decrease in the hematocrit and hemoglobin readings of the fluid.

Clotted hemothorax has been the subject of much controversy among thoracic surgeons in World War II. A distinction must be made between an inspirable hemothorax and a clotted hemothorax. The clotted hemothorax obviously is not aspirable, but it does not necessarily follow that the inspirable hemothorax is clotted. The traumatized chest wall and lungs are prone to form many bands and points of adherence which may make aspiration difficult or even impossible. Uninfected inspirable hemothorax is treated conservatively, by repeated attempts at aspiration, blood replacement, early ambulatory activity, and breathing exercises. If at the end of 5 weeks there was no evidence of expansion of the lung and disappearance of the blood, a thoracotomy and decortication were done.

The management of intrathoracic foreign bodies, abdominothoracic injuries, contusion of the lung, lung abscess, empyema, and wounds of the pericardium and heart is reported in detail, special emphasis being placed on the general care of the patient.

A low incidence of empyema, clotted hemothorax, operative procedures necessary, and the low mortality rate of 0.9 per cent are shown.

It is suggested that early, frequent aspiration, adequate blood replacement, and early ambulation are extremely important in the reduction of the incidence of complications.

It is further suggested that definitive treatment of penetrating chest wounds may be carried out most satisfactorily in the Forward General Hospitals.

JOHN E. KIRKPATRICK, M.D.

Harper, E. H. C., and Tait, G. B.: Pulmonary Edema in Chest Wounds. *Lancet*, Lond., 1946, 1: 533.

Pulmonary edema is the most serious complication in large lacerating wounds of the lung.

In the authors' cases, in spite of treatment with oxygen, atropine sulfate, and hypertonic plasma, all but 1 were fatal.

The one surviving patient, after receiving the usual treatment, finally underwent venesection and within an hour improved dramatically.



The mechanism of the production of pulmonary edema is discussed.

A warning is given against the use of intravenous infusions in severe chest injuries, as they tend to produce pulmonary edema. JOHN J. MALONEY, M.D.

**Mattel, C., Recordier, M., Metras, H., and Barbe, A.: An Attempt to Treat Pulmonary Suppurations with Endobronchial Installations of Penicillin** (Essai de traitement des suppurations pulmonaires par des installations endobronchiques de penicilline). *Presse méd.*, 1946, 54: 185.

As the systemic treatment with penicillin in cases of severe pulmonary abscess did not give satisfactory results, topical treatment was tried. Under control of the fluoroscope, rubber tubes were introduced into the abscess via the trachea and bronchi, and penicillin was applied locally. The results were far superior to those following systemic therapy. Fifty thousand units dissolved in 20 c.c. of serum were instilled twice weekly. Of a series of 12 cases of pulmonary abscess, 7 were cured completely, clinically and as shown by the x-ray findings. Four cases were cured clinically but showed some degree of shadow in the roentgenograms. The number of instillations necessary for complete success varied between 4 and 10. Nine of the patients had been treated with intramuscular injections of penicillin before they were given the instillations.

WERNER M. SOLMITZ, M.D.

**Brock, R. C.: Studies in Lung Abscess.** *Guy's Hosp. Rep.*, Lond., 1945, 94: 115.

The present article represents the first of a series of essays on lung abscess, based on 12 years' experience. The author discusses staphylococcal lung abscess. In the introduction he discusses the desirability of determining the type of lung abscess in each case of the disease.

The primary clinical picture is of a severe and overwhelming general infection referred to as "staphylococcal fever" frequently having the picture of a septicemia. It may be of sudden onset, beginning with symptoms suggesting pneumonia and pleurisy, and proceeding to the expectoration of sulficient sputum to suggest abscess formation. Involvement is frequently bilateral. Unilateral involvement is often massive and confluent.

The condition cannot be diagnosed by any one feature alone, but a combination of features is often sufficient to suggest the type of disease. Radiological examination may be strongly suggestive by the bilateral or multilobar involvement, and may present abscess cavities which often reach a large size and typically contain only a trace of fluid, or are completely empty. This is referred to as a "soap bubble" type of appearance. Very large tension cavities, or the onset of spontaneous or tension pneumothorax, especially in an infant, are very suggestive.

Proof, of course, depends on demonstration of the staphylococcus from the sputum, and/or the blood

stream, or in a secondary focus. The staphylococci may be present in pure culture, although mixed cultures are not uncommon.

Staphylococcal abscess of the lung was not seen as a sequel to aspiration of infective material from bad teeth, tonsils, or following operation on the upper respiratory passages.

"The absence of a predisposing cause for bronchial embolism, a very toxic or septicemic patient and large distention abscess or abscesses in the lungs without much retained secretion furnished the prima facie evidence for a diagnosis of a staphylococcal illness."

The author has treated 30 cases, with a mortality of 20 per cent. The cause of death was cerebral abscess in 2 cases, and pyemia or septicemia in the remaining 4 cases. Of the 24 patients that survived, 12 have no indication of permanent lung damage, whereas 12 have symptoms. Of this latter 12, 6 had had "chest trouble" previously. Empyema occurred in 10 of the 30 cases. The fact that pulmonary disease may well be active under the empyema in staphylococcal abscess is pointed out.

A rather detailed description of the clinical appearance and course of these patients is given, supported by 8 rather detailed case reports and 13 roentgenographic reproductions illustrating the various types of findings in this disease.

HIRSH T. LANGSTON, M.D.

**Adams, R.: Primary Lung Tumors.** *J. Am. Med. Ass.*, 1946, 130: 547.

A diagnosis of primary carcinoma of the lung was established microscopically in 157 consecutive cases at the Lahey Clinic in a 15 year period ending in December, 1944. The authors point out that most often early diagnosis is not made because the patient fails to seek medical advice or does not consider the complaint seriously enough to seek proper diagnosis. The symptomatology of cancer of the lung is largely explained by bronchial encroachment with varying degrees of obstruction or ulceration in that structure. The most common symptoms are: cough (93%); pain or chest discomfort (54%); sputum of varying types (53%); hemoptyses (44%); and wheeze caused by incomplete obstruction of the bronchus (14%). A sixth symptom not so frequently found was dyspnea, which occurred in 17%. The diagnostic procedures including sputum examination, bronchoscopy, roentgenography, and study of the pleural effusions and of biopsies were discussed. The article is summarized by the following statements:

Over a 15 year period from 1930 to 1944, with 164 consecutive cases of microscopically proved primary lung tumors, 7 nonmalignant tumors were observed. One was a myxochondroma and 6 were bronchial adenomas. There was no hospital mortality, and the 7 patients are alive and well at the present time.

There were 157 cases of carcinoma of the lung, and 49 patients (31.4 per cent) were submitted to surgical resection. Among the resected group, there were 8 hospital deaths (16.3 per cent). Twenty-three deaths

(46.9%) occurred subsequently because of recurrence of the disease. Four patients (8.1%) are living with evidence of recurrence. Fourteen patients (28.5% of 49 and 8.0% of 157) are alive and well at the present time with a chance for five year survival. Technical procedures have reduced the mortality to 3.3 per cent in the last 4 years.

consecutive resections.

Brown, B., Orr, E. M., Meads, M., and Finland, M.: Penicillin Treatment of Empyema: Report of 24 Cases and Review of the Literature. *Ann. Int. M.*, 1946, 24: 343.

It is generally believed that the sulfonamides will not cure empyema once frank pus develops. When properly used early in treating pneumonia, they will reduce the incidence of empyema, they are susceptible to penicillin, and will occasionally cure an early empyema without open drainage.

Penicillin should be more useful than sulfonamides in treating empyema, since the organisms frequently associated with empyema, namely pneumococci, hemolytic streptococci, anaerobic streptococci, phyllococci, fusospirochaetes, and others are more susceptible to penicillin. Penicillin diffuses from the blood stream into the pleural cavity and can be found in pleural fluids in concentrations which are somewhat lower than those of the blood. In accordance with the dosage, size of the cavity, and thickness of the wall, penicillin injected into the pleural space diffuses out into the blood stream slowly. Appreciable amounts are present in the pleural space from 24 to 72 hours after the injection. Penicillin's action is not inhibited by pus, tissue autolysates, or para-aminobenzoic acid. Its activity may be destroyed by certain micro-organisms or their products.

Since treatment is often prolonged, a less toxic drug like penicillin is preferred to the sulfonamides. A series of 24 cases treated with penicillin at the Boston City Hospital between March, 1944 and September, 1945, are reviewed. The ages of these patients varied from 4 to 72 years and three-fourths of them were 40 years or older. All but 4 were males. The empyemas followed primary pneumonia in 15 cases. In 2 cases they followed postoperative pneumonia; in 1 case the empyema was the result of atelectasis following a blow to the chest, in 1 it was part of a general sepsis, in 1 it was a chronic empyema of 20 years' duration, and in 4 cases the condition was a putrid empyema associated with pulmonary suppuration.

The pneumococcus was the most common organism, occurring in 14 cases. The alpha hemolytic streptococcus, anaerobic streptococcus, microaerophilic streptococcus, staphylococcus aureus, or mixed infections were found in the other cases. All but 3 patients received sulfonamides before penicillin was started, with no curative effect.

Intramuscular doses of penicillin averaging 120,000 U. daily were given to 22 of the patients for an average of 15 days. Intrapleural doses of penicillin

of from 5,000 to 200,000 U. were used with an average of 6 instillations.

The organisms were tested for sensitivity in 11 cases and all were found to be quite sensitive to penicillin. After a single intramuscular dose of 40,000 U. the concentration in the pleural fluid from 1 to 2 1/2 hours later ranged from 0.03 to 0.22 U. per cubic centimeter. The corresponding serum concentrations were from two to eight times as high. Concentrations as high as 40 U. per cubic centimeter were found in pleural fluid 24 hours after local instillations similar to those obtainable after the usual intramuscular doses were maintained for 24 hours after intrapleural doses of from 100,000 to 200,000 U.

Most of the patients improved markedly within 24 hours after penicillin treatment was started. 23 of the pleural fluid became sterile and remained so after a single intrapleural dose in 6 cases, after two injections in 5 cases, and after the sixth injection in 1 case. Frequently, organisms persisted in smears for several days after the cultures became sterile. Positive blood cultures were obtained at the time of admission in 7 cases. Penicillin seemed to decrease the volume of fluid that could be aspirated. Caused the foul odor of putrid empyema to disappear, and the patients became much better operative risks.

Of the 6 patients treated with penicillin and aspirations alone, 6 were cured (5 with pneumococcal and 1 with staphylococcal empyema). Two patients in the nonoperative group died of obscure causes. Operative drainage through a rib resection was carried out in 15 patients. Twelve were cured and 3 died; in 1 patient with putrid empyema the condition became chronic and a draining sinus was present 7 months after operation. Of the 4 patients with putrid empyema, 3 were cured, and 1 patient with nonoperative chronic empyema and a draining sinus while the operative group averaged 47 days in the hospital, the nonoperative cases averaged 86 days.

The authors analyzed the important features of 261 cases treated with penicillin collected from the literature, including their own 24 cases. All of these developed empyema on the basis of an antecedent pulmonary infection. Complete cures without resort to open drainage were obtained in 55.4 per cent of the group.

Rib resections were carried out in 40 per cent of the series. Seven nonoperative cases were cured with intramuscular injections of penicillin alone. The final results with respect to mortality and the percentage of cures or of cases that became chronic were essentially the same in the operative and nonoperative cases.

The most frequent organisms involved were the pneumococcus, beta hemolytic streptococcus, and staphylococcus, in that order. These are more favorably affected by penicillin than anaerobic streptococci or mixed infections. Of the cases of mixed infections only about one-fifth were cured without operation. The greatest percentage of deaths and chronic empyemas occurred in this mixed infection

group. The penicillin in these cases was given intrapleurally, intramuscularly, or both ways. There does not seem to be any correlation between the size of individual intrapleural doses, their number, or frequency. The most common intrapleural dose in use now is from 50,000 to 100,000 U. In two-thirds of the cases the penicillin treatment was given over a period of less than 3 weeks. In more than one-half of the 56 cases in which the number of injections required to sterilize the pleural fluid was stated, one or two injections were made. In 12 cases it was not sterilized at all. Systemic therapy is probably not essential in most cases if intrapleural injections of 100,000 U. or more are given at 24 to 48 hour intervals.

The susceptibility of organisms to penicillin, the duration of the illness, the thickness of the pleura, the presence of thick pus, fibrin clots, loculations, bronchopleural fistulas, or a draining sinus all play an important part in the sterilization and obliteration of empyema cavities. They may require surgical interference. Intramuscular administration of penicillin is particularly useful if the underlying pulmonary lesion is still active.

The greatest objection to the nonsurgical treatment of empyema has been the fear that the patient would be left with a thickened and immobile pleura, and that pulmonary function would be reduced. Impairment of function, pleural thickening, and other difficulties are not necessarily less, and may even be greater, following operation than in the cases in which operation can be avoided. Operations also leave ugly scars and considerable deformity.

The proportion of cures without operation has varied widely in different reports. Some authors have operated on practically all of their cases and concluded that penicillin has altered the treatment of empyema only slightly or not at all. Others obtained cures in almost all of their cases treated with penicillin and aspirations alone, and maintain that the need for rib resection has been markedly reduced. On the basis of accumulated experience, it seems evident that at present more than one-half of all cases of empyema can be cured by repeated aspirations and local instillations of penicillin into the pleural cavity.

The use of sulfonamides in treating pneumonia has not materially affected the incidence of empyema. It is expected that penicillin may do this. The indications for rib resection and the optimum time when it should be done when penicillin has been given remain to be worked out and will vary in different patients. In general, as long as the patient continues to improve, the cultures remain sterile, and the fluid diminishes in quantity, it is safe to continue with conservative therapy. Most patients who are eventually cured show marked improvement within the first 2 weeks.

It is not desired to leave the impression that rib resection and other forms of surgical drainage have been entirely replaced by penicillin therapy and simple aspirations. These operations will still be

necessary in many cases. However, now more empyemas than ever can be cured without open surgical drainage. This results in a shorter illness and a shorter period of disability.

ROBERT R. BIGLOW, M.D.

Platt, A. D.: Primary Mesothelioma (Endothelioma) of the Pleura. *Am. J. Roentg.*, 1946, 55: 173.

In a brief review of the literature on primary mesothelioma of the pleura, an incidence of 1.1 cases per thousand autopsies was reported by Saccone and Coblenz, with greatest frequency between the ages of 40 and 60 years, and, according to Birnbaum, a ratio of males to females of 2 to 1. He notes that the clinical findings are often reported to simulate those of a chronic inflammatory process, but that chest pain is early and persistent, and is accompanied by a dry cough, with rapid loss of energy and some loss of weight. Roentgen examination early in the disease has been found of little help in identifying the nature of the lesion, for it may show only a slight pleural effusion at the base of the involved lung. Later the effusion becomes massive and obscures the entire lung field, and only occasionally are tumor nodules visualized after a thoracentesis. Several authors have emphasized that when thoracentesis is attempted in these cases, the needle often seems to strike against firmly resistant tissue. The pleural fluid may or may not be bloody, and may or may not reveal malignant cells.

The author reports a case which, while showing the features outlined, demonstrates the difficulties encountered clinically in diagnosing pleural mesothelioma. The patient was a woman of 33 when first seen (in 1937) because of constant pain in the left lower thorax for several months, accompanied by a nonproductive cough, intermittent low grade fever, and fatigue. Physical examination disclosed tenderness over the left eighth rib but no abnormality of heart or breath sounds; the roentgenogram showed only rather minimal left pleural effusion. When she returned 15 months later, complaining of increased severity of the symptoms, dyspnea, and weight loss, there was both physical and roentgen evidence of the increase in the left pleural effusion, fracture of the left eighth rib, and apparent general enlargement of the cardiac silhouette. Cardiac disease was suspected, but the electrocardiogram was normal except for sinus tachycardia. Two months later (March, 1939) a dense nonpulsating mass was seen close to the left cardiac border, and the diagnosis was now thought to be bronchogenic carcinoma. Films taken in May, 1939 because of pelvic pain showed osteolytic metastases in the right innominate bone. Palliative irradiation to the thorax and the pelvis gave only transient relief of pain. During repeated thoracenteses it was noted that there was always difficulty in forcing the aspiration needle into the pleural space; no malignant cells were found in the aspirate. The patient became increasingly emaciated and died in October, 1939, over 2 years after the first onset of chest pain.

hemorrhage during the course of the cholecystectomy. Here again, direct ligation of the cystic artery and duct will avoid this complication. If severe hemorrhage does result from a cystic artery that slips through a clamp, rather than blindly clamp into the region of the artery one can control the hemorrhage by digital compression of the hepatic artery in its course anterior to the foramen of Winslow and then seek the offending vessel and clamp it individually. In those cases in which there is severe inflammation with much edema and inflammatory change in the tissues one may find that the ligature will cut through the cystic artery. In such cases the hemostatic clamp can be left on, the incision can be closed about the clamp and the clamp can be loosened and removed in 4 or 5 days. Cholecystostomy may be the procedure of choice in these cases, cholecystectomy being performed at a later date.

performance of choledochotomy, we feel that particular care should be exercised in exploration of the common duct and that exploration of the common duct should not be carried out unless there exist definite indications for it. The chronic obliterative cholangitis which these patients present is due to a slowly progressive chronic inflammation that destroys the normal epithelium and leaves a scarred, contracted, nearly obliterated common duct.

The presence of anomalies in the biliary system as well as in the corresponding vessels makes the direct ligation of the cystic duct and artery imperative. Eisendrath in his classic study showed the frequency of abnormal relations. He found that 17 per cent of cystic ducts parallel the course of the common duct, occasionally to within 1 centimeter about the ampulla. The cystic duct spiraled anterior, posterior or parallel to the cystic duct. The right hepatic artery may pass anterior, posterior or parallel to the cystic duct. The cystic artery may arise to the right or left or behind the common duct and may pass in front of it or behind it. The cystic artery is double in 12 per cent of the cases. We believe that the extensive obliteration of the duct system, which in many cases extended into the intrahepatic ducts, can be attributed to chronic inflammation of the epithelium of the ducts. At least 12 per cent of the patients can be classified on such a basis. In one case known surgical trauma was followed by such an extensive obliteration of the bile ducts. This no doubt may explain the obliteration of the bile ducts in other cases even though they also presented external biliary fistula. In consideration of the possibility of this lesion resulting from rigorous curettage of the mucosa of the bile duct in

We wish to emphasize that this group of patients do tolerate operation well and we believe that this fact should encourage surgical exploration in an attempt to re-establish the continuity of the biliary system, even in those cases in which the risk is considered to be grave. One is greatly impressed with this ability to undergo extensive operations, for these 188 patients underwent a total of 496 operations with only a 12 per cent mortality rate for the 188 procedures which we are studying. Two hundred and fifty-seven of these operations had been performed elsewhere. The ability of the liver to maintain a satisfactory function after years of constant injury is manifested by the 4 patients who suffered from symptoms of cholangitis for 10 to 12 years but were still alive at the time of the latest report.

Nearly a half of the patients who were well, 2 to 12 years after their reconstructive operation, had suffered from symptoms of biliary dysfunction which had subsided entirely. We would stress this fact in any evaluation of patients who return after a reconstructive operation for further management. Although many of these patients had chills, fever, jaundice and an enlarged tender liver at one time, they later became free from symptoms. One such patient after choledochoduodenostomy had suffered from symptoms of cholangitis for 2 years but had been entirely free of symptoms for 7 years at the time of the latest report. Apparently cholangitis is the factor present in these cases rather than a mechanical obstruction. Patients who have cholangitis improve when treated with sulfonamide drugs and when simultaneously the rate of flow of bile is increased by use of bile salts and increased ingestion of fluids. One can be aided in de-

At autopsy the left visceral and parietal pleurae were found diffusely thickened, studded with nodules and adherent to each other and to the pericardium, except where separated by loculated bloody fluid. The left lung was atelectatic and contained scattered discrete tumor nodules, as did the right lung. There was a right serofibrinous effusion, and the right visceral pleural surfaces were tumor-studded but not otherwise thickened. No evidence of a primary bronchial tumor site was found. The tumor tissue had invaded the pericardium diffusely and there was an accompanying pericardial effusion. The left eighth rib was the site of a small osteoclastic metastasis. No abdominal visceral metastases were found. The microscopic sections showed the left pleura tremendously thickened by tubules, columns, nests, and sheets of large anaplastic pleomorphic nuclei, some in mitosis, embedded in fibrous stroma, and filling countless lymph spaces.

LILIAN DONALDSON, M.D.

### MISCELLANEOUS

Nicholson, W. F.: Penetrating Wounds of the Chest. *Brit. J. Surg.*, 1946, 33: 257.

The author presents a survey of 1,639 penetrating chest wounds seen in the Middle East and Central Mediterranean Forces. The patients were received immediately after being wounded up to 3 or 4 weeks after being wounded, according to the tactical situation. The overall mortality was 4.27 per cent.

On x-ray, wounds of the lung may present the missile track, although most often a pulmonary hematoma is the pathological picture. Such intrapulmonary hemorrhage was believed important in producing a "wet lung." Most of these resolve spontaneously. "A few pass on to pneumonia; fewer still to an abscess." Atelectasis was common, particularly in the presence of hemothorax. Bronchoscopy was infrequently used.

Pneumothorax alone is infrequent although it is present, in some degree, in all penetrating wounds. Tension pneumothorax was seen in 1.5 per cent of all cases. Of 24 patients, 10 died later of sepsis.

Hemothorax occurred in 1,027 cases, or 62.6 per cent of the series. Of these, 718 remained uninfected and fluid; 217 were infected and fluid; 92 were clotted. Seventy-five per cent of the last group were infected. Empyemas occurred in 22.3 per cent. There were 8 cases in which further bleeding into the pleura occurred 24 hours after wounding.

There were 61 clotted or loculated hemothoraces on the right, and 32 on the left. Evacuation of the clot and decortication were employed in such cases.

Five factors which favor the development of a chronic empyema are listed: (1) the wound of the lung may produce a permanent scar with inability of the affected lung to expand; (2) prevalence of staphylococcus aureus infection, an organism which produces no fibrinolysin; (3) retained foreign body; (4) bronchopleural fistula; (5) fibrin deposit on the visceral pleura, which is tough and unyielding.

There were 164 thoracoabdominal wounds, 101 on the right and 63 on the left. Conservatism in the management of liver injuries was more common than operation, and when the latter was carried out the abdominal root seemed to predominate. Subphrenic abscesses were seen in the proportion of 13 on the right and 7 on the left. Six cases of bile pleuritis became infected. There were 2 cases of bronchobiliary fistula. The mortality at the Base Hospital in thoracoabdominal wounds was 22 per cent.

Intrapleural foreign bodies were seen in 39 cases with empyema in 26. Intrapulmonary foreign bodies, 1 by 2 centimeters in size, were removed, as well as the intrapleural ones. Smaller foreign bodies were removed after resolution of the pulmonary hematoma. Eight cases of lung abscess due to a retained foreign body were seen.

Foreign bodies in or near the pericardium were removed, particularly if there was evidence of "recurrent pericarditis from irritation by a foreign body."

Foreign bodies in a vertebral body, particularly in the presence of infection, constitute a serious problem.

A program of rehabilitation is stressed. Breathing exercises are important, but caution against instituting them during active phases of infection is given.

Eight case reports, including good illustrative roentgenograms, are used to document the discussion.

HIRAM T. LANGSTON, M.D.

Rose, T. F., and Newson, A.: Treatment of Gunshot Wounds of the Chest in the Field Aided by Penicillin Therapy. *Med. J. Australia*, 1946, 1: 290.

The authors report 32 cases of gunshot wounds of the chest with intrapleural involvement. The treatment was based on adequate resuscitation, early excision and suture of the wounds, early and repeated aspiration of hemothoraces, and early thoracotomy for fibrinohemothorax and pleural infection.

Penicillin therapy, both intrapleural and intramuscular, was used as an adjuvant in all cases.

SAMUEL KAHN, M.D.

Santy, P., Bérard, M., and Maillet, P.: Gas Embolism in Thoracic Surgery (Les embolies gazeuses en chirurgie thoracique). *Lyon chir.*, 1945, 40: 681.

The authors report 10 observations of a complication which is the most difficult to avoid in thoracic surgery, namely, gas embolism. The authors are dealing only with so-called arterial gas emboli which pass the left side of the heart and show a tendency to enter one of the branches of the aorta in an ascending direction. In view of the usual position of the patient the embolus most frequently enters the carotid arteries. The most important signs of gas embolism are syncope, epileptiform crises, and hemiplegia. If syncope does not lead to a fatal

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outcome it is followed by a more or less prolonged coma. Epileptiform crises are either generalized or of the Jacksonian type and, as a rule, are not accompanied by a loss of consciousness. Hemiplegia or monoplegia is relatively rare, may or may not involve the face, and is sometimes accompanied by aphasia and conjugated deviation of the head and eyes. Pallor, profuse perspiration of the head and ing, and dilatation of the pupils complete the clinical picture. Respiration is slow and labored, frequently stertorous, and cyanosis is frequently observed. The authors stress the great frequency of a sudden malaise preceding the appearance of objective signs. There are other important symptoms such as amaurosis, and cardiovascular and cutaneomucous signs. Amaurosis is probably caused by an embolism of the retinal arteries. Extrasystolic arrhythmia and, strangely enough, arterial hypertension are constant signs, although of short duration. The classical windmill murmur signifies the "barbotage" of air within the heart. Erythematous patches on the face, neck, upper extremities, trunk, and the mucous membranes of the tongue and cheeks, surrounded by pale zones, are bizarre phenomena. Such cutaneous lesions may change their shape and location and may reappear in old places, the changes being due to the movements of the peripheral emboli and topographic modifications of the stasis of the blood.

Of 10 cases of gas embolism observed by the authors 5 ended fatally. Gas embolism following thoracoplastic operations seems to be a rarity.

A too vigorous lavage of the pleural cavity or introduction of a drain may produce gas embolism in some cases.

The authors have noticed repeatedly that embolism originates during the inspiratory phase of respiration, which produces a dilatation of the alveoli and pulmonary veins.

Insufflation, puncture, or exploration of the pleural cavity should not be undertaken until one is sure that the tip of the needle is within the pleural cavity. No air should be injected under high pressure, especially if the existence of a circumscribed cavity is suspected. If symptoms of gas embolism appear, the patient's head should be lowered to prevent the entrance of the air into the carotid arteries. Before a resection of a lobe or its portions, the pulmonary parenchyma should be clamped. No brisk traction should be applied in order to avoid an injury of the lung tissue. Pneumotomy should be performed only with an electric knife which produces a progressive coagulation of the tissues. Finally, the authors advise covering the operative field with large pads soaked in saline solution so that a protective liquid layer is created.

As to the curative treatment, the patient's head should be lowered, the wound should be covered with wet compresses, and vasodilating drugs such as papaverine or acetylcholine should be employed. Cyanosis should be combated with oxygen inhalations, and artificial respiration is indicated in syncope. The authors highly recommend intravenous injections of from 10 to 15 c.c. of novocain.

JOSEPH K. NARAT, M.D.

# SURGERY OF THE ABDOMEN

## ABDOMINAL WALL AND PERITONEUM

Stajano, C.: The Supposed Difference in the Defensive Power of the Peritoneum in Distinct Sectors of the Abdomen (La pretendida diferencia defensiva del peritoneo en los distintos sectores del abdomen). *Rev. mex. cir.*, 1945, 13: 102.

In this polished disquisition on the philosophy of error, the distinguished Uruguayan professor of clinical surgery attempts to limit himself to that particular sophistry, prevalent in the medical profession and particularly among surgeons, which teaches that there is a difference in the defensive reaction between the peritoneal surfaces of the lower and upper sectors of the abdominal cavity. He does not try to prove by positive evidence that Ranvier was wrong in asserting that there were distinctive differences between the lymphatic arrangement of the lower and upper abdominal regions, or that Clark—also about the turn of the century—was practically in error in recommending his declivitous posture for the patient, viz., almost a Trendelenburg posture, to favor the reabsorption of the products of peritoneal effusion or hemorrhage. Nor does he say that Fowler's position for surgical patients has not been of any practical value. He merely states that today there is no basis for the profession's being guided by these conceptions.

These erroneous ideas arose during the period when morphology rather than physiology dominated surgical thought, when judgments based on anatomical structure were the mode in surgery, and subsequent investigators piled error upon error in trying to prove that this theory was true, instead of trying to establish its authenticity. For instance, it was pointed out that the pelvic peritoneum resists infection much better than the peritoneum in the upper abdominal regions. However, in recent years it has been shown that there is no basis for such an assumption. The apparent difference was due to the prevalence of gonococcus infections in the lower abdominal regions, and it is known that the gonococcus is by nature a fragile organism and is incapable in itself of much aggression within the body. It is the exotoxins and particularly the endotoxins of the gonococcus which produce the congestive and exudative manifestations which look so virulent to us. On the other hand, the streptococcal involvements of the lower abdominal regions, such as the puerperal abscesses of the tubes and ovaries, are just as virulent and deadly as streptococcal infections anywhere else in the body.

In the upper abdominal region the grave prognosis of infections of the biliary tract was assumed to be due to the spongelike absorptive capacity of the peritoneal surfaces about the diaphragm, but no notice was taken of the fact that infradiaphragmatic abscesses allowed of about as much tempo-

rizing and were almost as easy to cure as the corresponding involvements of the pelvis. It is now shown that the deaths from biliary infections are due to injury to the parenchyma of the liver rather than to special conditions of defense reactivity and absorption of the peritoneum.

The surgeons of the early nineteen hundreds were timidly attempting gastroenterostomies and gastrotomies for cancer of the esophagus and blaming their failures on the special conditions to be encountered in the peritoneum of the upper abdominal cavity, rather than on the true causes, such as failure of the suture line, occlusion of the neostomies, intestinal loop herniations, high intestinal occlusions, and hemorrhage into cavities or into the peritoneal cavity itself. All such accidents were ascribable to the operator himself or to his preparation of the patient. Today the simple closure of perforated gastric and duodenal ulcer and the vast excisions of the upper alimentary tract, with or without drainage, discredit any such theory as a special fragility of the upper peritoneal cavity.

All in all it seems that the peritoneum possesses an extraordinary capacity for defense throughout all sectors of the abdominal cavity, and that it is the particular biologic qualities of the individual invading organism, and its particular intensity and modality of aggression which determine the differing gravity of the processes within the general abdominal cavity. Fowler's position is of value because it transports the products of infection to regions of the body, such as the cul-de-sac of Douglas in the woman, where drainage may be more easily and effectively done.

JOHN W. BRENNAN, M.D.

Figari, A.: The Causes of Acute Peritonitis Observed at the Autopsy Table (Le cause delle peritoniti acute osservate al tavolo anatomico). *Polidlin., sez. prat.*, 1946, 53: 61.

The author presents a statistical analysis of cases of acute peritonitis seen at postmortem examinations at the Policlinico, Umberto 1, between 1937 and 1942.

Deaths from acute peritonitis were found to account for 5.7 per cent of the total autopsy material during the period under observation; appendicitis and postoperative peritonitis were the etiologic factors in 22.3 per cent and 18.5 per cent, respectively. In 13.7 per cent of the cases the peritonitis was attributed to perforated gastric and duodenal ulcers, while in the remaining 46 per cent it was due to strangulated hernias, gynecological lesions, perforations of the gastrointestinal tract due to neoplasms, volvuli, perforated typhoid ulcers, suppurative processes, and unclassified ulcers of the small and large intestine.

The deaths from complications of appendicitis were found to decline from 25.2 per cent in 1937 to

19.6 per cent in 1942, while perforations from peptic ulcers were seen to rise from 12.6 per cent to 17.5 per cent. Postoperative peritonitis maintained a constant rate of 20.7 per cent until 1942 when it fell to 7.2 per cent. EDITH FARNSWORTH, M.D.

Mosto, D., and Pastorini, R.: Pseudomyxoma of the Peritoneum (Pseudo mixoma peritoneal). *An. Ateneo Inst. maternidad*, 1945, p. 65.

The 5 patients observed by the authors were from 25 to 60 years of age (2 males and 3 females). In 4 appendectomy was performed. One patient had undergone an appendectomy and presented a fistula discharging gelatinous material. In 4 of these cases the diagnosis was appendicitis (in 1 instance with a perforated appendix). The remaining patient exhibited a chronic follicular appendicitis with peri-appendicitis and vasculitis, and the terminal portion of the small intestine displayed a dense crop of milium granulations over an area of 10 sq. cm., which proved on histologic examination to consist of vascularized, myxomatous granulations containing glandular structures of appendicular type.

In 3 of these patients the picture was that of a secondary specific irritation of the peritoneum by the mucous deposits, and in the others the picture resembled that of implants of glandular tissue from the appendix to the peritoneal surfaces.

The authors believe that their material supports the statements of other authors (von Rubnitz and Hermann: *Archives of Pathology*, 1943, 36: 297), that there are 2 forms of pseudomyxoma of the peritoneum of appendical origin—one a benign type which will often disappear when the appendix itself is removed, and the other a form with mucosal implants, which are apt to undergo malignant degeneration, especially if the process spreads extensively over the peritoneal cavity. This last form requires postoperative irradiation, and in spite of this may terminate fatally. JOHN W. BRENNAN, M.D.

Thompson, G. C. V., and Chambers, C. H.: Chylangioma of the Mesentery, with Report of a Case, and a Brief Discussion of Mesenteric Cysts. *Med. J. Australia*, 1946, 1: 210.

A chylangioma of the mesentery has been defined by Ewing as a cavernous lymphangioma containing milky fluid, which arises from congenital or acquired obstruction of the lacteal vessels. Chylangioma constitutes one type of true mesenteric cyst, in that it conforms to the definition of a mesenteric cyst given by Higgins and Lloyd, who held that mesenteric cysts were cysts which occurred in or near the mesentery, which were not malignant, dermoid, or parasitic, and which did not arise from any normally placed retroperitoneal organ.

Chylangiomas are considered benign tumors whose embryonic origin is stressed by many authors. They occur most frequently at the primitive centers of origin of lymph tissue in the embryo.

Macroscopically, chylangiomas are well differentiated from surrounding tissues, having a capsule

which varies with the size of the cysts, with their situation, and according to whether they are pedunculated or sessile, or whether they project between the layers of the mesentery. The tumor may be a single cyst or a multilocular cyst with cystic spaces of varying size; it may be entirely cystic or partly fleshy.

The authors report a case of chylangioma of the mesentery at the duodenojejunal junction. The cyst had the features of a true tumor of the lacteals. The confused classification of mesenteric cysts was discussed, and an attempt was made to describe common types of mesenteric cysts. The clinical signs, symptoms, diagnosis, and treatment of mesenteric cysts were briefly stated. CHARLES BARON, M.D.

### GASTROINTESTINAL TRACT

Ricketts, W. E., and Pollard, H. M.: A Roentgenological and Gastroscopic Study of Gastric Disease. *Gastroenterology*, 1946, 6: 1.

The purpose of this report was to present an analysis of a series of 1,297 patients with gastric disease who were studied both by means of x-rays and gastroscopy. In general, it was agreed that the shape, contour, motor function, and gross lesions are seen better by means of the x-rays, while mucosal changes and small lesions are seen better with the gastroscope.

Duodenal lesions obviously not detectable by gastroscopy were excluded from the analysis. Cases with gastroscopic and roentgenological findings were not considered.

In 60 of 172 cases in which both examinations were negative, no satisfactory clinical diagnosis was made, and in 112 cases the clinical diagnosis included a wide variety of extragastric disorders and diseases.

In 46 of the 355 cases with conflicting gastroscopic and roentgen findings, gastroscopy failed to reveal lesions shown by the x-rays, including 22 cases of benign ulcer, 21 of carcinoma (11 proved at operation or autopsy), 2 of benign polyposis, and 1 case of gastric diverticulum. Conversely, positive gastroscopic and negative roentgen findings were obtained in 309 cases, including 269 cases of chronic gastritis, 26 of benign ulcer, 10 of carcinoma (diagnosis proved at operation or autopsy in 5), 4 of benign polyps (1 with malignant degeneration and 3 with a gastroscopic and roentgenological diagnosis of carcinoma proved to be tumorlike gastritis by histological examination).

In the complete clinical study of gastric disease gastroscopy and roentgen study are invaluable, although not infallible procedures.

JOHN H. MOHARDT, M.D.

Oppenheimer, A.: The Supine Projection in the Diagnosis of Lesions of the Corpus and Posterior Wall of the Stomach. *Am. J. Roentg.*, 1946, 55: 454.

In many patients undergoing roentgenography for lesions of the stomach, a lesion is not suspected or





Fig. 1. Left, the patient is a male, aged 52, with gastric distress. The large ulcer of the posterior gastric wall was not seen in the prone oblique and, right, prone positions, but is well shown in the supine position.

recognized until revealed by supine views. Consequently, spot roentgenograms of an involved area are often omitted and a negative report is made if the supine view is not taken. The long period spent during detailed spot roentgenogram studies of series of patients sometimes causes visual fatigue which is responsible for poor diagnostic results. In more cases than it seems to be realized, accurate roentgenographic technique yields results that are equal in value to those which are obtained with spot roentgenograms.

The author uses the supine and supine oblique projections to demonstrate lesions not ordinarily observed in the upright and prone positions. Although in nearly 80 per cent of the cases the morbid condition can be revealed in the prone, prone oblique, and upright views, in the remaining 20 per cent it cannot be demonstrated unless supine projections are used. This is true especially when the corpus and posterior wall of the stomach are involved.

The author's observations suggest that roentgenography of the stomach in the supine and supine oblique positions is indicated when the clinical manifestations strongly point to a gastric lesion but the usual roentgen methods fail to reveal such a lesion. The technique of the method is outlined in detail.

HAROLD LAUFMAN, M.D.

Dohn, K., and Faber, B.: Invagination of the Stomach. *Acta radiol.*, Stockh., 1945, 26: 56.

The Danish literature had previously reported a case of invagination of the stomach which was diagnosed at post mortem. The present case was diagnosed during life. The case was that of a woman, 71 years of age who was diagnosed on roentgen examination as having an invagination of the stomach. On roentgen examination made 11 days subsequently the invagination had disappeared. About a month later the patient died from other causes, and a post-mortem examination was performed. The fundus of the stomach showed a myoma on a stalk the size

of a green walnut: this was the primary cause of the invagination.

The different types of invagination of the stomach are discussed in this article. Twenty-four cases were investigated in the available literature. The underlying cause of invagination had in all cases been a tumor, which practically always was benign and stalky. Among these cases it was possible to diagnose 6 of 14 by means of roentgen examination. The typical subjective and objective symptoms during life are those of pyloric obstruction.

RICHARD J. BENNETT, JR., M.D.

Tomenius, J.: The Cytological Diagnosis of Gastritis. *Acta. med. scand.*, 1946, 123: 417.

The author presents clinical results of his study of the gastric juices from 15 patients without gastric pathology, and 13 with gastritis. His observations were well controlled. Customary clinical examinations were made: The anamnesis and clinical status were determined, roentgen films of the stomach and duodenal bulb were made, the acidity was determined according to Ihre, and gastroscopy was done. The position of a special tube by which continuous suction was applied separately in the lower esophagus, lower stomach, and duodenum was controlled by fluoroscopy. Fractional samples of the gastric juice, protected by 1.3 per cent solution of bicarbonate dripped continuously into the upper stomach, were obtained. Contamination from saliva could be controlled by the presence of squamous cells in the gastric juice; the quantity of trypsin in the gastric juice was a check on duodenal contamination. The fasting patients were subjected to gastric lavage with from 300 to 400 ml. of tepid water in 30 or 40 ml. portions in the morning. Secretory stimulation was obtained by an injection of 1.0 mgm. per 10 kgm. of body weight. Cellular digestion of the samples obtained was controlled by incubation at 37° C. of neutralized gastric juice.

The conclusion is made that in cases of gastritis an outflow of leucocytes occurs, which has more than 1

to 10 cells per field of vision seen in normal individuals. In 1 case of chronic gastritis no cells were found. In 1 case of pernicious anemia the outflow of cells disappeared after therapy with liver preparations.

JAY P. BARTLETT, M.D.

Moses, W. R.: Diverticula of the Stomach. *Arch. Surg.*, 1946, 52: 59.

Diverticulosis of the stomach is an uncommon condition, as is evidenced by the fact that only about 150 cases have been reported. The most frequent site of occurrence is on the posterior wall near the lesser curvature in the cardiac region. In approximately 30 per cent of the reported cases there have been other associated gastroduodenal conditions, more likely to cause symptoms than the diverticulum itself. About 1 in every 3 diverticula will be the site of adverse symptoms. The condition has no characteristic, or even suggestive, symptoms that would tend to differentiate it from other far more common lesions of the upper gastrointestinal tract. The eventual diagnosis will usually be made only on the observations at autopsy, or at operation; or by the results of several roentgenological studies of the gastrointestinal tract, or by gastroscopic examination. It is easily missed by any of these methods.

A case is presented which illustrates rupture and bleeding into the peritoneal cavity due to a gastric diverticulum. The diagnosis was made clinically by an uncommonly fortunate series of events. This complication of diverticulum of the stomach has not been previously reported in the literature.

JOSEPH GASTER, M.D.

Hartman, F. W.: Curling's Ulcer in Experimental Burns. The Effect of Penicillin Therapy (Correlation of Observations with Other Recent Evidence Regarding the Pathogenesis of Peptic Ulcer). *Gastroenterology*, 1946, 6: 130.

Of 28 control dogs receiving third degree burns over from 50 to 60 per cent of the shaved body surface, all animals examined showed positive blood cultures, and 77.7 per cent developed acute duodenal ulcers. In the case of 10 other dogs with similar burns, penicillin in amounts ranging from 10,000 to 50,000 units daily was given intramuscularly. The penicillin reduced the incidence of duodenal ulceration in these dogs from 77.7 per cent in the untreated control group to 23 per cent in the treated group. This occurred in spite of the fact that (a) penicillin inhibits the growth of only certain types of bacteria, and (b) relatively small and infrequent daily doses of penicillin were given.

The author's experimental data indicate that the local and resulting systemic infection produced in these dogs with burns was of major etiological importance in the total pathogenesis of the acute duodenal ulcers. Congestion and edema of the duodenal and gastric mucosa have been noted in many of the dogs with burns. Evidence has been outlined which strongly suggests that this mucosal congestion constitutes the precursor or background

for subsequent ulceration. It is interesting that these observations harmonize with the recent classical observations of Wolf and Wolf upon their human subject. They too noted mucosal congestion with associated marked increase in the susceptibility of the mucosa to slight trauma as the first stage in the pathogenesis of their experimental ulcers. In their human subject, certain strong emotions were the cause of the mucosal congestion. In the dogs with burns complicated by shock and infection, the shock was presumably the cause of the mucosal congestion. Detailed pathological evidence has demonstrated that the final stage of duodenal and gastric ulceration in these dogs is a corrosive and not a local infectious process.

CHARLES BARON, M.D.

Blinder, I., Ruby, V. M., and Shuman, B. J.: Tuberculosis of the Stomach with Special Reference to Its Incidence in Children. *Gastroenterology*, 1945, 5: 474.

Tuberculosis of the stomach is uncommon in all age groups and particularly in children. A review is presented of 61 cases (collected from the literature) of gastric tuberculosis in children 15 years of age and younger. The ratio of incidence of gastric tuberculosis in adults and children is 5 to 1, in contrast to previous reports of lower ratios.

The most common lesion is ulcer, which occurred in 95 per cent of the cases. The pars pylorica and the body of the stomach are more frequently involved than the cardia. Attempts to explain the infrequent occurrence of gastric tuberculosis have been manifold but inconclusive.

Possible routes of infection include hematogenous, lymphogenous, serosal, and mucosal (direct) routes. The authors are in agreement with those who deny the possibility of the mucosal method of infection.

Vomiting, emaciation, and diarrhea are the most frequent symptoms. These, however, are not reliable in making a specific diagnosis, nor are determinations of gastric acidity, gastroscopic examination, and roentgenographic studies of conclusive value.

The diagnosis of gastric tuberculosis in children must be considered in patients with known or suspected tuberculosis who also present symptoms referable to the gastrointestinal tract.

JOSEPH GASTER, M.D.

Riveros, M., and Thompson, Q. C.: Considerations on a Case of Multiple Gastric Polypoid, Hypertrophic Gastritis, and Cancer of the Pyloric Antrum (Consideraciones acerca de un caso de polipoides gástrica múltiple, gastritis hipertrofica y cancer del antro pilorico). *An. Fac. cient. med.*, Asuncion, 1945, 5: 9.

Riveros and Thompson reported the case of a 56 year old single man with vague symptoms of the upper gastrointestinal tract for 10 years, who then developed symptoms of pyloric obstruction with increased gastric motility which could be seen through the abdominal wall.

A subtotal gastric resection was made and he was found to have multiple gastric polyposis, hypertrophic gastritis, and a pyloric cancer producing obstruction.

WILLIAM E. RICKETTS, M.D.

**Raimondi, P. J., and Collen, M. F.: Recurrence Rate of Symptoms in Peptic Ulcer Patients on Conservative Medical Treatment.** *Gastroenterology*, 1946, 6: 176.

A study was made of the recurrence rate of symptoms in 151 patients with the clinical and roentgenographic diagnosis of peptic ulcer who were treated with a standard conservative medical regimen.

The recurrence rate of symptoms was found to be remarkably constant. During the first year of treatment an average of 5 per cent of the patients each month had a first recurrence of symptoms. At the end of the first year two-thirds of all the patients had suffered a first recurrence. Of those that escaped symptoms the first year, two-thirds had a first recurrence in the second year of treatment.

During the period of observation, from 1 to 2 3/4 years, 39.1 per cent of the patients had but a single recurrence. The majority of the patients treated over 2 years had multiple recurrences.

Only 10.6 per cent of the patients on this therapeutic regimen received no relief of symptoms during a recurrence. Of 106 patients treated over 1 year, 42.5 per cent had symptom free periods lasting from 1 to 2 1/2 years.

Although treatment of the symptoms of active peptic ulcer is very satisfactory (relief was obtained in 90 per cent of patients), the high incidence of recurrences (in 83 per cent of the patients treated for 2 years) indicates that the chief therapeutic problem in the management of peptic ulcer is the prevention of exacerbations.

JOHN J. MALONEY, M.D.

**Moore, F.D., Chapman, W.P., Schulz, M.D., and Jones, C. M.: Transdiaphragmatic Resection of the Vagus Nerves for Peptic Ulcer.** *N. England J. M.*, 1946, 234: 241.

In 1929 Hartzell, using dogs, demonstrated in a convincing manner three fundamental points relative to the vagus nerves. The first is that section of both nerves decreases the acidity of the gastric contents. The second is that this section cannot be adequately done unless it is made through the chest. The third point is that if the section is technically incomplete, the effect is disappointing and transient. A restudy of the dogs 3 years after the initial operation showed a return of the acidity. This finding prompted the authors to carry out the most complete vagus resection possible in the lower chest and upper abdomen.

Smithwick has shown that a lasting result can best be obtained by radical extirpation of the autonomic system involved. This fact led the authors to perform a vagus resection in which the nerve is resected from just below the lung root to well down on the stomach wall. Smithwick has also shown that the autonomic nervous system regenerates rapidly, particularly through tissue planes and ordinary liga-

tures; therefore, the authors believe that ideally the diaphragm should be cut and interposed between the cut ends of the nerves.

With these considerations in the background, work in this field was begun at the Massachusetts General Hospital, Boston, early in 1944, and to date 15 patients have been operated on. Of the 15 cases, the authors report on 12. These 12 cases represent some of the most difficult therapeutic problems encountered in this field. They were selected because of the long duration and intractability of the symptoms as well as the past and present complications. All of the patients had had one or more rigorous terms of hospital medical treatment in an attempt at relief. They were chosen in the hope that good or bad results would soon become apparent, and with the idea that a maintained good result was significant and not due to chance factors.

The authors have routinely novocalinized both vagus nerves above the point of manipulation and have given rather large doses of atropine either before or during the operation.

The report of the clinical results in these 12 cases must be regarded as an interim one, because it will be many years before this operation can in any way reach final evaluation.

Following operation, as a general rule, the patients were allowed to eat and drink anything they wished, including alcohol and coffee, since it was believed that the operation would not be put to an adequate test if a patient was carried along on conscientious medical therapy.

The place that this operation will ultimately occupy in the surgical armamentarium is at present not clear. In view of the present limited knowledge and experience with the operation, little can be said concerning its limitations. It is clearly not indicated in acute perforations, acute massive hemorrhage, or advanced cicatricial obstruction, and these situations should be dealt with by appropriate surgical maneuvers other than vagus resection. Beyond these obvious contraindications, the authors have not yet found criteria by which patients can be excluded from the possibility of benefit from this procedure.

The occurrence of bleeding in the past is no contraindication to the operation.

Gastric ulceration proximal to the pylorus should be approached with the greatest caution, so far as this operation is concerned. The reason for this is that although the diaphragm is open, the region of the ulcer cannot be adequately visualized and palpated, and even if it could be, it is often impossible to differentiate ulcer from cancer. Resection should therefore usually be employed in such cases.

Patients who have had other surgery, such as pyloroplasty, posterior gastrojejunostomy, or gastric resection, and who present themselves with renewed ulceration are ideal subjects for this procedure. The previous surgery does not in any way complicate the operation, and it may be carried out with excellent relief of symptoms in cases in which renewed attack on local structures through the ab-

domen would be technically complicated, with the end result open to question.

The largest group of cases in which this procedure seems to be of value is that of young or middle aged men with a long history of peptic ulceration, possibly with previous perforations or hemorrhages, unobstructed and not acutely bleeding, who have been refractory to careful medical therapy and who have severe ulcer pain in times of stress, which can be relieved transiently by the usual antacid, milk, or food. This type of patient obtains a uniformly good result from the procedure, but the duration of the relief is at present unknown.

JOSEPH GASTER, M.D.

Bonorino, C., D'Alotto, V., and Ramos, M. M.: Retrobulbar Ulcers of the Duodenum (Las úlceras postbulbares del duodeno). *Arch. argent. enferm. ap. digest.* 1945, 20: 340.

The authors found 6 cases of ulcer beyond the duodenal bulb in a series of 2,135 duodenal ulcers studied at the Dispensary of Gastrointestinal Diseases in Buenos Aires. These ulcers were located above the ampulla of Vater.

The somatic as well as the clinical symptoms were not different from those of ulcers located at the duodenal bulb. Two of such cases had massive bleeding.

The authors stressed the fact that frequently these ulcerations have been confused with diverticula of the duodenum. WILLIAM E. RICKETTS, M.D.

Brunschwig, A., and Tinholtz, J. C.: Surgical Treatment of Malignant Tumors of the Duodenum Exclusive of Those Arising from the Papilla of Vater. *Surg. Clin. N. America*, 1946, 26: 163.

The authors review the literature on resections of the malignant tumors in the duodenum, exclusive of those arising from the papilla of Vater, and report their personal experience with 5 cases attacked surgically.

The surgical attacks consisted of:

1. Resection of the tumor and portions of the duodenal wall involved
2. Resection of a segment of duodenum and adjacent segment of the head of the pancreas
3. Pancreatoduodenectomy to resect the entire duodenum and head of the pancreas.

In the first case roentgenograms revealed a polypoid tumor mass in the lower portion of the second segment of the duodenum. Operation consisted of exposure of the carcinoma in the second portion of the duodenum by a longitudinal incision through the anterior wall of the first and second portions of the third segment of the duodenum. Repair of the resected portion of the posteromesial wall with the tumor was then made by interrupted sutures. The transected common bile and main pancreatic ducts, respectively, were transplanted into the upper angle of the wound in the duodenum. The resected tumor arose in the lower portion of the second segment of duodenum and involved the papilla of Vater secondarily, compressing it upward but not infiltrating it.

Histopathological study revealed this to be a medullary carcinoma of the duodenum. The patient is well and normally active 7 years and 10 months after operation.

In the second case roentgenograms revealed a stenosing lesion that was thought to be in the terminal pylorus. At laparotomy a scirrhous carcinoma was found which involved the first segment of the duodenum and infiltrated downward into the head of the pancreas. There were no apparent metastases. The growth was removed by a segmental resection through the lower one-third of the stomach and by transection of the duodenum at the junction of the lower two-thirds of the second segment with its upper third. The common bile duct and portal vein were not injured. For restoration of gastrointestinal continuity, a posterior polygastricostomy was performed.

Histopathological study revealed an adenocarcinoma arising in the first segment of the duodenum and infiltrating the subjacent pancreas. The patient was well for one year, then presented a palpable epigastric mass that was moderately tender. Laparotomy was again performed, at which time a dense fist sized mass of recurrent carcinoma was present over the head of the pancreas. In the attempt to resect this the portal vein was opened and its ligation was necessary. The patient succumbed in shock 3 hours later.

In the third case roentgenograms revealed a large ulceration of the wall of the third portion of the duodenum. At operation a large spindle celled sarcoma arising from the third portion of the duodenum with ulceration at one point was found. The neoplasm partially surrounded the superior mesenteric vessels and also extended posteriorly and superiorly behind the head and body of the pancreas. Metastatic lymph nodes were present along the greater curvature of the duodenum. A segmental resection was performed by transecting the jejunum about 3 c.c. beyond the ligament of Treitz and invaginating the distal end. The duodenum and the head of the pancreas were transected about 2 cm. below the papilla of Vater. Gastrointestinal continuity was re-established by duodenoduodenostomy. The pancreatic and common bile ducts were not injured.

Histological study revealed a spindle celled sarcoma. Sections of several lymph nodes revealed metastatic sarcoma. The patient is alive and well 3 years after operation.

In the fourth case the patient had a round celled sarcoma, or lymphosarcoma, involving the duodenum from the upper curvature almost to its termination. The patient in the fifth case had a carcinoma of the third segment of the duodenum invading the adjacent lower portion of the head of the pancreas and its uncinate process. The former patient, who was in a poor nutritional state, died on the seventh postoperative day; the latter lived 3 months after operation, but died from a deep abdominal abscess that developed after he returned home.

Extensive malignant neoplasms of the duodenum require complete excision of the duodenum. This can be accomplished only by concomitant resections of the head of the pancreas.

Pancreatoduodenectomy was originally devised for resection of carcinomas of the head of the pancreas. However, large duodenal neoplasms will usually involve the head of the pancreas and therefore this method of operation is also indicated for such growths.

Reconstruction of the upper alimentary tract after one-stage pancreatoduodenectomy consists of: choledochojejunostomy, cholecystojejunostomy, gastrotrojunostomy (Billroth II), implantation of the transected neck of the pancreas into the jejunum, and enterointerostomy between the jejunal loops going to the biliary tract.

Operations as described should be carried out under continuous spinal anesthesia, and the systolic blood pressure should be maintained at at least a pressure of 100 mm. of mercury.

General conclusions are not yet possible in regard to the surgery of primary malignant neoplasms of the duodenum. Pancreatoduodenectomy is the most radical procedure, but good results have been achieved with more conservative measures. Each patient presents individual problems which must be evaluated if the surgeon is to carry out the best operation for that patient.

JOHN H. MOHARDT, M.D.

Etchepareborda, J. A., and Stapler, N. M.: The Value of Roentgenology in the Diagnosis of Tuberculosis of Bauhin's Valve (El valor de la radiología en el diagnóstico de la tuberculosis de la válvula de Bauhin). *Arch. argent. enferm. op. digest.*, 1945, 20: 291.

The authors discussed the roentgenological aspects of tuberculosis of Bauhin's valve of the cecum, illustrating the different types of lesions and describing 5 varieties.

In the first type there was a stenosis of the valve which produced dilatation of the ileum.

In the second the incontinence of the valve allowed the passage of gases to the small bowel; this could be visualized with x-rays.

In the third there was the Bonnamour-Bernay-Badolle sign which consists in the deformation of the cecum and is produced by the intussusception of the ileum.

In the fourth was found the Fleischner sign, a thick diffuse infiltration of the valve with retraction of the cecum, simulating an opened umbrella of which the handle is the ileum.

In the fifth was found the "crown sign," produced by the infiltrated borders of the cecal valve. An oval or circular lesion is found where the ileum opens into the cecum.

One case of tuberculosis of the cecal valve was reported, and a case in which such a lesion was suspected was found to be normal at operation.

WILLIAM E. RICKETTS, M.D.

Glenn, P. M., and Read, H. S.: Tuberculous Ulcerative Colitis or Ulcerative Colitis with Superimposed Tuberculous Infection. *Gastroenterology*, 1946, 6: 9.

A case of ulcerative colitis with ischio-rectal abscess, from which tubercle bacilli were isolated, is reported. The role of the tubercle bacillus in this patient is a perplexing problem. The ulcerative tuberculous type of intestinal lesion is almost invariably secondary to a tuberculous focus elsewhere in the body. The respiratory tract is most often involved and the bowel lesions are usually manifestations of an overwhelming infection. McGlannon and others have expressed the belief that tuberculous lymphadenitis and tuberculosis of the genito-urinary tract may be primary foci for intestinal tuberculosis. Tuberculosis in other organs is present in from 95 to 97 per cent of the cases. Babinski was unable to find pulmonary lesions in only 5 of 285 subjects with intestinal tuberculosis who came to autopsy. Primary intestinal tuberculosis is a rare disease in the United States.

Clinically, the patient had no pulmonary symptoms, and produced no sputum, and repeated gastric washings revealed no acid fast organisms. However, his mother died at the age of 47 in a tuberculosis sanitarium and 1 brother had tuberculosis.

Although a calcified Ghon complex was present in the lungs, no active pulmonary tuberculosis was demonstrable at autopsy.

The girdlelike ulcerations of the colon were suggestive of tuberculosis, but the histological evidence was not conclusive. In the rectum and the ischio-rectal abscess, the histological picture was indicative of tuberculosis.

The findings indicate that tuberculous infection played a definite role in this disease. The temporary improvement in association with sulfa and penicillin therapy may have been due to the effect of these agents on the pyogenic organisms. The possibility that the tuberculous infection was a superimposed infection is purely speculative. The superimposition of tuberculous infection upon a previous idiopathic colitis must be considered a possibility.

JOHN H. MOHARDT, M.D.

Vernengo, M. J., and Villafañe, E. P.: Solitary Diverticulitis of the Cecum (Diverticulitis solitaria del ciego). *Prensa med. argent.*, 1946, 33: 506.

The authors' patient, a male 47 years of age, had been troubled for a long time by gastric disturbances with the sensation of heaviness in the abdomen following meals. Twenty-four hours before admission to the hospital there had been an onset of diffuse abdominal pain, which later localized in the right iliac fossa. Inspection disclosed some elevation of the abdominal wall in the right lower part of the abdomen, the underlying mass apparently moving with respiration. The mass was about 5 cm. long and 3 cm. wide, extremely painful on manipulation, and slightly mobile both vertically and horizontally. A certain amount of tympany and a few borborigmi could



Fig. 1. Roentgenogram made with an opaque enema

be elicited. Contrast roentgenography brought out the condition shown in Figure 1, which is not discussed and which evidently did not lead to clarification of the condition, since the operation was undertaken for a possible typhilitis of undetermined etiology or on a diverticular basis.

At operation under spinal anesthesia, the incision was made between the second and third lumbar spines and carried through the rectus abdominus muscle. Raquiperlain, 7.5 mgm. with 8 cm. of spinal fluid, was used. A small amount of serous fluid in the peritoneal cavity and an inflammatory mass on the outer side of the cecum were found. The mass was firmly adherent to the parietal peritoneum and measured about 4 by 3 cm. in size. It was freed by resection of the parietal peritoneum. The inflammatory condition had extended over on to the cecum for an area of about 5 by 3 cm. The ileocecum was resected, the ileum to about 10 cm. from the ileocecal valve and the cecum to about 3 cm. above the valve. An ileocolonic laterolateral isoperistaltic anastomosis was effected with catgut and linen sutures. Careful peritonization of all the raw surfaces and closure, layer by layer, of the abdominal wall were done without drainage.

The postoperative course was normal, and the patient was up and about on the twelfth day.

JOHN W. BRENNAN, M.D.

**Vignard, P.: Reflections on the Retrocecal Appendix with Regard to an Unusual Complication** (Réflexions sur l'appendicite sous-coecale a propos d'une complication rare). *Lyon chir.*, 1945, 40: 602.

In 2 instances, rather atypical symptoms of appendicitis led to laparotomy and the finding of a

chronically inflamed cecum and retrocecal appendix. A difficult appendectomy was carried out, including ligation at the base and inversion of the stump into the cecum in the usual manner, with a gauze drain to the surface for 2 or 3 days following operation. In the 1 case, after 2 days, and in the other, after 14 days, copious bleeding appeared in the form of blood in the stool, which persisted until the patients were rendered dangerously anemic. In 1 case repeated blood transfusions were required before the condition could gradually be induced to disappear.

These 2 experiences raise a question in the author's mind as to the advisability of burying the ligated stump of the appendix in the cecum when both the appendical walls and those of the neighboring cecum are apt to be friable and congested. There is also the question as to the need, on occasion, of reopening the laparotomy wound and opening the cecum itself in order to get at the bleeding point. In neither of the author's 2 patients did he do this, but he does not pretend that he acted in the most logical manner, and he entreats others who may have found themselves in analogous situations to relate to him their experiences and their opinions concerning this matter.

JOHN W. BRENNAN, M.D.

**Manzella, M.: Acute Volvulus of the Appendix** (Volvulus agudo del apéndice). *Rev. As. med. argent.*, 1945, 60: 1352.

Manzella reports a case of acute volvulus of the appendix vermiformis, which was preoperatively diagnosed as acute phlegmonous appendicitis. At operation, the appendix was found to be covered by an apparent phlegmonous finger of omentum; on removal of the omentum, an anemic knotted twist of the appendix was revealed at its proximal third level. Above the knot and up to the cecum, the appendix was congested. Below the knot the appendix graduated into a gourd shaped necrotic tip. The mesoappendix appeared normal. The rotation was in the longitudinal axis from left to right.

A considerable discussion concerning the hypothesis of torsion of the appendix was given.

STEPHEN A. ZIEMAN, M.D.

**Vallazza, E.: Carcinoid of the Ileocecal Appendix** (Carcinoide del apéndice ileocecal). *An. Inst. maternidad, B. Air.*, 1944, 6: 111.

This affection has many synonyms. It has been called pseudocarcinoma, lipid cancer, argentaffine tumor, cancer of the basal cells of the intestines, and neoplasm of the mucosa.

Carcinoid is a rare entity, and one that is most difficult to diagnose. It occurs between the ages of 20 and 30 years, and most frequently in women. The origin of the tumor is in dispute—some consider it as arising from the cellular structure of the glands of Lieberkuhn, others associate it with certain eosin cells, and still others think it arises from lymph follicles.

termining the degree of mechanical obstruction by use of duodenal intubation in discovering whether bile is flowing into the duodenum in satisfactory amounts. If it becomes evident that one is dealing with a mechanically malfunctioning anastomosis, then re-exploration is indicated if the condition of the patient warrants further surgical treatment.

One probably obtains the poorest results in all surgery from attempts at reconstruction of the biliary duct system. However, when one considers the hopelessness of the situation without surgical intervention, the results can be viewed much more optimistically. Thirty-six per cent of all the patients were well 2 years or more after the reconstructive operation and a total of 67 per cent were alive. Of the 31 per cent who had symptoms of cholangitis and obstruction that persisted, a half required further attempts at reconstruction.

Actually in certain selected cases, reconstruction operations can be very satisfactory. If injury or severance of a common duct is recognized immediately and repaired, the ultimate result is quite satisfactory. Too, when there remains a long segment of common duct and the diameter is sufficient to enable the surgeon to do choledochoduodenostomy without the use of a Mayo-Sullivan tube or catheter, the results are gratifying. Sixty-two per cent of these patients were well 2 to 12 years after operation and less than a third of the 62 per cent had had temporary symptoms of cholangitis. If one elects to use a catheter or tube in performing choledochoduodenostomy, the results may be only slightly less gratifying according to our study, in which 55 per cent were living and well 2 to 12 years after the operation. When a T tube reconstruction was used the results proved only two-thirds as good as when choledochoduodenostomy was performed without a tube. Why this is true is not entirely apparent; it may be that removal of the T tube causes injury to the anastomoses and allows subsequent strictureing.

When the common duct is destroyed and one is compelled to use the hepatic duct in performing hepaticoduodenostomy, the results are the least favorable of all the recon-

structions. Only 28 per cent of the patients were alive and well 2 to 12 years later.

It is surprising to discover that 4 (21 per cent) of the patients who underwent hepaticostomy in which an external biliary fistula was established were entirely well and without biliary drainage. A spontaneous internal fistula developed, and the patients gave a history of discharge of food particles for a time prior to closure of the external fistula. Therefore, if one is compelled by necessity to resort to hepaticostomy when an external biliary duct is not identified, all hope should not be abandoned. In one case in which there was a permanent external biliary fistula, a visit at the clinic 4 years later revealed the patient to be in relatively good health and able to perform her duties. She takes her own bile by mouth and her intake of calcium is high. A high intake of calcium must be maintained to prevent osteoporosis, which develops in patients who lose the biliary excretion.

Progress has been made in the management of a complication that has arisen in the evolution of biliary surgery. The place that the vitallium prosthesis will come to occupy remains to be ascertained. However, we wish to reiterate that the best treatment for benign stricture of the bile ducts is prevention, which can result only by impressing the seriousness of the problem on surgeons and by their adherence to rigid care in actual identification of the structures that they are handling when performing biliary operations.

#### SUMMARY

Benign stricture of the bile ducts is a tragedy for the patient and for the surgeon. In nearly three-fourths of the cases such a tragedy might well have been averted. However, there are certain strictures, at least 12 per cent in this study, which can best be explained on the basis of low-grade chronic inflammation, so called chronic obliterative cholangitis.

Although surgical results are far from being all that can be hoped for, nevertheless, surgical treatment does offer a real hope in certain types of stricture, for after choledochoduodenostomy 55 to 62 per cent of the patients

Of the 84 cases reported by the author, only 3 showed evidence of metastasis. With complete surgical excision the prognosis is good; however, if extension to the glands has occurred, the prognosis is bad.

It is nearly impossible to make a clinical diagnosis because the symptomatology is indicative of the organ affected. Vallazza's patient was diagnosed as having chronic appendicitis. At operation a tiny tumor was found on the top of the appendix. The pathological report was returned as carcinoid of the ileocecal appendix. The patient has been examined periodically for 1½ years, and there has never been any evidence of recurrence. STEPHEN A. ZIEMAN, M.D.

**Castro, J.: Cancer of the Rectosigmoid and of the Sigmoid** (Cancer recto sigmoideo y sigmoideo). *Bol. Soc. cir. Chile*, 1945, 23: 121.

The material here reported consists of 27 patients with rectal and anorectal cancer, and 10 with sigmoidal cancer. With the exception of 7 cases (seen in private practice, but with the same criteria of treatment), they were observed on the surgical service of F. de Amesti at the hospital of San Salvador, Santiago, between the period from June, 1938 to July, 1945. All of the cases were instances of the relatively radioresistant adenocarcinoma, with the exception of 1 case of solid papillary cancer of the intermediate type of anorectal origin which had invaded the rectum secondarily; however, this case was given the same treatment as the others. The majority of the patients were of middle age, from 40 to 60 years old, and there was a slight predominance of the male sex. It took the usual extended length of time before the condition was properly recognized. There were 12 rectal and rectosigmoidal cancers and 2 carcinomas of the iliac sigmoid in which the condition was not recognized until more than a year after the initiation of symptoms, and in 1 instance 2½ years had elapsed before the patient entered the hospital. The usual symptom leading to diagnosis was constipation, but intervention for acute obstructive symptoms—diarrhea, hemorrhage, pain, tenesmus, and colicky attacks—was necessary in only 3.7 per cent of the cases. Secondary anemia was present in 10 instances, but was due to small continuous blood losses rather than to massive hemorrhage.

These conditions had to be taken into consideration in preparing the patients for operation. It was necessary to do a decompressive operation as an emergency measure only once; however, a considerable number of the patients gave a history of acute or subacute obstructive conditions which had been relieved by medical measures. The poor quality of the material required long, careful preoperative preparation of the patient in order to combat the dehydration, anemia, avitaminosis, and vascular disturbances. During a preparative period of some 2 weeks or more, an albumin-rich, high-calorie diet (poor in residue), blood transfusions in cases of anemia, plasma transfusions in shock and hypoproteinemias, and copious quantities of fluid (given orally or

intravenously) were administered; this permitted types of operations that were highly radical in character. The bowel was kept relatively empty with laxatives and enemas, but when the obstructive manifestations were more severe, a cecostomy, colostomy, or enterostomy was done to decompress the bowel and improve the general condition of the patient. After operation the use of an indwelling Miller-Abbot tube for 4 or 5 days proved invaluable. The sulfa drugs, preferably given orally before and after operation, gave the impression of suppressing pulmonary complications. Sulfaguanidine, associated with sulfathiazole, was given from 4 to 6 days preoperatively and injections were continued for 4 or 5 days postoperatively. The author believes that a medical internist and a urologist should always be brought into consultation in the preoperative period, and cites a case history in which the urologist stated that the recurrence in the bladder was undoubtedly the result of an extension of the tumor to the bladder which should have been detectable preoperatively.

During the operation, blood or plasma in amounts up to 500 or 1,000 c.c. were administered and the procedure was repeated that same evening or the next day. No particular method of anesthesia was employed exclusively, the choice of modality being left largely to the judgment of the anesthetist.

Twenty-one rectal and rectosigmoidal, and 10 iliac-sigmoidal carcinomas were brought to operation; of the former, 10 underwent a purely palliative procedure (colostomy) and 10 were operated upon radically, 9 by the one-stage, abdominoperineal, somewhat modified technique of Miles, and 1 by two-stage abdominoperineal resection. One additional case was subjected to colostomy, but the patient refused resection. There were 2 deaths in the hospital (1 from peritonitis and 1 from operative shock); 2 patients died somewhat later of metastasis; 1 patient survived for 3 years and then died of pulmonary metastases; 1 patient operated on in 1941 has not been heard from; and 1 with the bladder condition cited earlier died of local recurrence. Therefore, 4 patients are still alive; they are well after the following periods: 6 years and 2 months (1), 2 years (2), and 3 years (1). Of the 10 cancers of the ileum and sigmoid, 2 were resected by Rankin's method for tumors of this region; 3 patients underwent the Mikulicz operation, 2 were subjected to resection with end-to-end anastomosis, 2 underwent the palliative operation of Hartmann, and 1 was subjected to a cecostomy. There were no operative deaths; 1 patient is perfectly well after 2 years and 10 months; 1 was reoperated upon 5 years later for another cancer of the ascending colon and now, 2 months later, is entirely well; 1 died after 2 years and 6 months of hepatic metastases; 1 was re-examined 2 years and 9 months after operation and was found to be perfectly well; 1 died 2 years and 2 months after operation because of recurrence at the point of the enteroanastomosis; 1 who had undergone the Hartmann operation died 4 months later of abdominal carcinosis; the other patient undergoing the Hart-



mann operation was still well 5 months after the operation, and the last patient (Mikulicz operation) has not been heard from since operation.

The most troublesome and persistent postoperative complication cited by the author was that of male impotence, which developed in 4 of his patients and seemed to be irreparable.

In the discussion period, RAHUSEN cites the diagnostic value of the passage of mucus independently of defecation and the purely palliative value of radiotherapy in the adenomas, with preliminary derivative operative measures to reduce the inflammatory factor which, according to this author, appreciably inhibits radiosensitivity. LABACA notes that tumors of the right colon exhibit periods of diarrhea, while those of the colon descendens are characterized by obstinate constipation. He has observed that propagation of the neoplasm takes place much more often by contiguity than by lymphatic dissemination.

JOHN W. BRENNAN, M.D.

Duckerts, J.: A Contribution to the Study of Anorectal Cancer (Contribution à l'étude des cancers anorectaux). *Rev. belge. sc. med.*, 1944, 16: 125.

This careful and somewhat laborious study of anorectal cancer is based on 26 cases seen between 1927 and 1942 at the Anticancer Center at the University of Liege. The article is written in the French style of thesis, taking up methodically every aspect of the subject. There is, for instance, a discussion of the anatomy, frequency, etiology, pathological anatomy, microscopic and macroscopic extension (local and distant), diagnosis, treatment, and results. In each of these sections the views of other authorities are taken up and discussed, and then these views and statistics are compared with the cases in this study. The work has been carefully done and is well documented and may be well worth consulting by anyone especially interested in this type of work.

Anorectal cancer is rare at this clinic representing 1 per cent of all malignant lesions; however, it is a serious disease as only 1 case of the 26 was cured, 3.8 per cent. The poor results are attributed to delay in the diagnosis, almost half of the patients being inoperable when first seen. Both the patient and the physician were deemed blameworthy in not resorting earlier to biopsy. There was a tendency on all sides to regard the disease as of a chronic inflammatory nature. Furthermore, favorable response to x-ray and radium therapy delay the use of more radical measures until they in turn are unsuccessful. The average patient presenting himself with what he considers a relatively minor lesion is astounded when it is proposed that he have a temporary colostomy, a wide surgical excision of the lesion, and a course of radium or x-ray therapy. This form of treatment instituted at an early date is, nevertheless, the only way of obtaining a good result.

A biopsy was obtained in 22 of the 26 cases, and it was found that there were 11 epitheliomas and 11

adenocarcinomas. It is stated that not all the lymphatics of the cutaneous region of the anus go to the inguinal lymph nodes, but that some follow the superior hemorrhoidal artery to the inferior mesenteric nodes. The earliest symptoms are pruritis, bleeding, and pain; later there may be hemorrhage, difficulty in defecation, tenesmus and distortion in the size and shape of the stools. The differential diagnosis is from tuberculosis, actinomycosis, chancres, fissures, fistulas, thrombosed or ulcerated hemorrhoids, condyloma, and fibrous stricture of the rectum. Actually, the diagnosis depends on biopsy. The treatment of choice is a colostomy followed by wide surgical excision of the lesion and either x-ray or radium therapy. ADRIEN VER BRUGGEN, MD

#### LIVER, GALL BLADDER, PANCREAS, AND SPLEEN

Flynn, J. E.: Pyogenic Liver Abscess. *N. England J. M.*, 1946, 334: 403.

Pyogenic organisms may enter the liver by one of the following ways: through the portal vein from organs drained by it, from blood-borne infections through the hepatic artery, by direct extension from a contiguous infection, and from trauma. The organisms that cause pyogenic abscesses are generally sensitive to the sulfonamides or penicillin. These organisms usually are the colon bacilli, streptococci, and staphylococci. The pus is frequently sterile in liver abscesses.

Two currents of blood in the portal vein have been demonstrated, the one from the superior mesenteric vein which leads to the right lobe of the liver, and that from the inferior mesenteric and splenic vein which leads to the left lobe.

Grossly, the liver is enlarged and the abscesses are usually multiple. Multiple abscesses give the liver a mottled appearance. The usual symptoms are chills, fever, pain, and profuse sweating. With acute suppurative appendicitis complicated by pyelophlebitis and multiple abscesses of the liver, fever is of the "picket-fence" type and is usually accompanied by daily chills. Pain is felt in the right upper abdominal quadrant and is usually constant. Jaundice occurs infrequently and is usually a late serious sign. The elevation and immobility of the diaphragm, usually on the right side, as seen by means of x-rays are of great diagnostic value. Exploratory aspiration of the liver for the detection of pus is dangerous and should not be done.

Death occurs in from 50 to 95 per cent of the cases. Incision and drainage is the proper treatment. An extraperitoneal anterior or posterior approach is made, according to the location of the abscess. Chemo-therapy should play a significant role in the treatment. If an operation is performed, a culture is important to determine what therapeutic agent is to be used.

The author reports a case of multiple pyogenic abscess of the liver due to nonhemolytic streptococci with no demonstrable focus. The organism was sen-

# GYNECOLOGY

## ADNEXAL AND PERIUTERINE CONDITIONS

Blackwell, W. J., Dockerty, M. B., Masson, J. C., and Mussey, R. D.: Dermoid Cysts of the Ovary; Their Clinical and Pathological Significance. *Am. J. Obst. Gyn.*, 1946, 51: 151.

For the purpose of this study, the records in 225 consecutive cases of dermoid cysts of the ovary removed at operation in the Mayo Clinic were reviewed. One hundred consecutive tumors of this group were examined macroscopically, and from 10 to 15 sections were removed from the cyst wall for microscopic study. In a few instances, the size of the tumor permitted the selection only of from 2 to 5 sections; but in every cyst, these sections were taken at scattered areas in order that the structures of the cyst wall should be well represented.

These data permit the following conclusions:

Ectodermal derivatives were present in 100 per cent of the tumors, mesodermal structures in 93 per cent, and endodermal derivatives in 71 per cent.

The high percentage of mesodermal and endodermal elements was due to the fact that multiple sections were examined microscopically. Serial sections would probably have revealed more.

The term "dermoid" is inaccurate and should be replaced by the term "cystic teratoma."

The hypotheses that have been advanced to explain the histogenesis of these neoplasms do not explain their origin adequately.

These tumors occurred with equal frequency in each ovary. Twelve and four-tenths per cent were bilateral. The average diameter was 8.2 cm. The incidence of cystic teratomas was 5 per cent of all ovarian neoplasms. Malignant lesions occurred in 3 per cent of the cystic teratomas. Symptoms associated with these cysts had no differential diagnostic value.

Surgical removal was the treatment of choice, but, when possible, resection of the tumor was done to conserve ovarian function.

Numers, C. von: A Contribution to the Case Knowledge and Histology of the Brenner Tumor. *Acta obst. gyn. scand.*, 1945, 25: 114.

The author describes 2 cases of Brenner tumors from the Helsingfors University Gynecological Clinic. One of these was a typical case of solid Brenner tumor, while the other was a Brenner tumor combined with a pseudomucinous cystadenoma. In addition, he describes 2 cases in which ovarian tumors containing Brenner epithelium and pseudomucinous epithelium were definitely malignant, both histologically and clinically.

The author suggests that while none have yet been described, there may well be malignant forms of the Brenner tumor. The last 2 cases described may represent examples. DANIEL G. MORTON, M.D.

## EXTERNAL GENITALIA

Papanicolaou, G. N.: A General Survey of the Vaginal Smear and Its Use in Research and Diagnosis. *Am. J. Obst.*, 1946, 51: 316.

The use of the vaginal smear for determining the time of ovulation requires considerable training and experience. The interpretation of findings is often difficult. Local infections (bacterial or parasitic) causing leucorrhea tend to modify and obscure the normal picture.

A complete evaluation of the normal sex cycle in women requires an examination of vaginal smears not only during the follicular and postovulatory stages but during all phases of the cycle.

One field in which the progress has been rather slow is that of the diagnosis of pregnancy. Changes typical of gestation appear in the vaginal smear as early as the thirty-eighth or fortieth day and become more accentuated in advanced stages.

In normal gestation one can recognize some abnormal features suggestive of threatened abortion, such as blood, excessive mucus, pronounced acidophilia, or intracellular blood pigmentation. In abortions and ectopic pregnancies, one usually finds moderate bleeding with high fibrination, marked acidophilia, and modified pregnancy or postpartum cells. A point of interest and of some diagnostic value in abortions is the increase in number and the phagocytic action of the histiocytes and the polymorphonuclears. They engulf and destroy not only bacteria and detritus, but also erythrocytes.

The application of the smear test as a method of evaluating ovarian insufficiency and as a guide in hormonal therapy has since been greatly extended, and its value is now being generally recognized.

Smear reports for cancer should be conservatively worded and the findings corroborated as often as possible by curettage or biopsy before any major operation is decided upon. No case should be reported as definitely positive unless the evidence is overwhelming.

Although the preparation and staining of smears is relatively easy, their interpretation is rather difficult. It is based on cytological criteria and requires special study and training.

The nuclear changes of cancer cells seem to offer the most reliable diagnostic criteria. One should refrain from basing a positive diagnosis exclusively on the presence of modified superficial cells. It is also unsafe to consider as absolutely conclusive the vacuolization of cells or their infiltration by leucocytes, as these changes may occasionally be found in other conditions, such as hyperplasia, metaplasia, or endometritis.

Evidence is presented that neoplasms of the urinary organs, including the bladder, prostate, and kidneys, can be detected by the smear method,

patient at the time of injury, and the presence or absence of associated injuries are definite factors affecting the mortality. There is no group of wounds which requires more early, energetic teamwork and co-operation on the part of the entire hospital staff and nursing service than gunshot wounds of the abdomen, and a recognition of this fact will be an appreciable factor in the reduction of mortality from such injuries.

CHARLES BARON, M.D.

**Wagner, A.: Four Cases of Diaphragmatic Intumescence. *Acta radiol.*, Stockholm, 1945, 26: 239.**

The author has recently seen 4 patients of whom chest films showed a rather large rounded shadow occupying the angle between the right cardiac border and the dome of the diaphragm, each of the shadows being of a different etiology although all were similar in appearance. Barium by mouth showed one of these shadows to be that of an eccentric hernia of the cardioesophageal opening, which was believed to be associated with a congenitally shortened esophagus, in a boy 6 years old with no complaints referable to the anomaly.

The second case was that of a woman 63 years old with hypertension, dyspnea, ascites, ankle edema, and jaundice. Chest films showed a normal appearing heart, but revealed a rounded shadow occupying the right pericardiophrenic angle. Barium given by mouth revealed no relationship of this mass to the gastrointestinal tract and kymography showed that the tumor did not move when the patient held her breath; however, it did move during respiration and was more pronounced during inspiration. A definite diagnosis could not be arrived at roentgenologically. Autopsy confirmed the clinical impression of cirrhosis of the liver with ascites and chronic perihepatitis, and showed that the bulge in the diaphragm was due to the formation of an encapsulated serous cavity between the liver and the diaphragm.

The third instance occurred in a man of 74 years who complained of a sensation of slight pressure in the chest and palpitation. His blood pressure was 160/90. The electrocardiogram and roentgen examination of the biliary and gastrointestinal tracts revealed nothing abnormal. The chest films, however, showed two rounded shadows bulging into the pericardiophrenic angle, and medially, a suggestion of arched extension of the pericardium across the intumescence. The large tumor mass did not pulsate. No certain diagnosis was established, but the author believed this mass was probably a lipoma arising from subpericardial adipose tissue. The author makes reference to a similar case published by Sauerbruch in which operative proof was obtained.

The fourth case was that of a man 24 years old, a farmer and football player, who had been well until the age of 18 when he developed palpitation for 6 months. At that time his heart was found so far to the right that his physician diagnosed situs inversus. Two years later the symptoms recurred and were accompanied by severe pain. The electrocardiogram was normal. Chest films showed the heart to be displaced to the right but of normal size and shape, and in the right pericardiophrenic angle, independent of the heart and somewhat posterior to it, but closely related to the diaphragm, was a rounded mass the size of a hen's egg. There was no evidence of associated pulmonary inflammation or atelectasis although the adjacent pulmonary vessels were somewhat distorted. Kymography revealed no significant pulsation, and when barium was given orally no relationship was found to the esophagus or gastrointestinal tract. At operation a portion of normal liver was found to have herniated through the diaphragm. A constricting groove was split, the hernia reduced, and phrenicotomy done.

LILLIAN DONALDSON, M.D.

small, and (2) the bleeding may have been the result of hyperemia due to pelvic inflammation which should have been cleared up before treatment was started by means of short waves, sulfonamides, or protein therapy.

The 16 successful cases are divided into four groups, a typical case history being given briefly for each. The first group comprised those patients in whom the bleeding ceased with the first treatment and the subsequent menstrual cycle was normal—menorrhagia for several years. The case cited in exemplification of this group was that of a woman of 46 years, who had an intense proliferative phase of the endometrium (anovular cycle). The use of 250 mgm. of testosterone propionate resulted in the cessation of abnormal bleeding and 3 months later a micro-encrustage of the mucosa showed it to be in repose with a tendency toward atrophic changes (menopause).

In the second group were the women in whom the reduction of the bleeding occurred abruptly following several monthly treatments and the cycles came regular thereafter. The illustrative case was that of a woman of 42 years, who suffered with menorrhagia every 15 days. The first dose of testosterone consisted of 125 mgm., then two further doses of 75 mgm. each were given at two month intervals, which resulted in a tapering off of the bleeding with ultimate normalcy of the cycle.

The third group included the patients in whom the treatment produced an actual cessation of the hemorrhage, followed by a period of amenorrhea of variable duration and then by subsequent normal periods. The case history reported was that of a 31 year old female with biopsy findings of typical glandular hyperplasia of the endometrium, in whom injections of 50 mgm., 25 mgm., and 25 mgm. at daily intervals resulted in the cessation of the bleeding. This condition then persisted for more than 2 months, but after this regular menstrual periods reappeared.

The fourth group included the cases in which the periods were regular for some time after treatment but the hemorrhages recurred later and required a second treatment to produce definitive regular menstrual periods. The case cited for this group was a woman of 31 years with biopsy findings revealing a metropathy with enormous proliferation. The hemorrhage ceased after 175 mgm. of testosterone were administered; however, the next period was again hemorrhagic, and 100 mgm. of testosterone were administered in the interval; this resulted in two subsequent normal menstruations. The next period administered during the succeeding interval resulted in a less abundant period of bleeding, and 75 mgm. administered during each of the two succeeding intervals finally achieved normal menstruation lasting for the succeeding 8 months of observation.

JOHN W. BRENNAN, M.D.

Trillat, P., and Burthiault, R.: *Pelviparietal Phlegmon, A Special Type of Phlegmon of the Broad Ligament* (Le phlegmon pelvi-pariatal, forme particulière des phlegmons du ligament large). *Rev. fr. gyn. obst.*, 1945, 40: 368.

The authors define a special type of pelvic phlegmon as pelviparietal phlegmon of the base of the broad ligament. It is located near the sciatic spine and is adherent to the pelvic wall. It is distinguished from phlegmon of the hypogastric sheath or of the base of the broad ligament by the fact that it is separated from the cervix uteri by a groove. This type of phlegmon has been described earlier in the literature but not identified as a special type. It is frequently discovered at vaginal examination following persistent temperature after delivery or abortion. In palpation for diagnosis the two hands are used alternately. The cervix and uterus may be in normal or abnormal position and also the cul-de-sacs may appear normal, but exploration of the pelvic walls will reveal the phlegmon as a hard, slightly tender mass plastered against the pelvic wall. Its exact position can be demonstrated by a film centered on the lateral wall of the pelvis on the involved side, the anterior and inferior limits of the lesion being identified with the aid of two fingers in the vagina which have been rendered visible by the insertion of lead wire under the finger nails. The parietal mass may vary in size, shape, sensibility, and consistency, but it is always separated from the cervix uteri by a groove.

The symptoms may be absent, mild, moderate, or severe, according to whether one has to deal with an adenolymphitis, a pyohemic form, or a form of venous involvement with suppuration. There are also early forms, developing on the second or third day after delivery or abortion, and late forms, appearing after 15 days. The lesions may be very ferentiated from oöphoritis, and late forms, appearing after 15 days, of mixed type, and must be very tractable of the levator ani, and must be very lymphitis due to cervical pathology or endometritis.

Although the prognosis is good, and con- retrogression the rule, recovery is usually slow, taking from 15 days to 3 weeks or more. The mass grows progressively softer, the groove disappears, and healing is complete. In some instances a small nodule the size of a nut may persist for some time before final healing. In other cases the original structure undergoes elongation into a cordlike form before it disappears. Possible complications include pulmonary symptoms, a cordlike uterovaginal phlebitis, pulmonary infarct, lung abscess, or purulent pleurisy may ensue with death.

The authors have observed 33 cases over a period of 13 years, including 21 mild cases of adenolymphitis, 9 cases with signs of venous involvement such as pulmonary infarct or phlebitis of the lower limbs, and 3 cases of suppurative uterovaginal phlebitis. Because of the possible venous involvement in the pelviparietal region, patients should not be per-

which may prove to be helpful in diagnosing these neoplasms and in following up their treatment.

EDWARD L. CORNELL, M.D.

### MISCELLANEOUS

Lintgen, C., and Herbut, P. A.: Clinico-pathological Study of 100 Female Urethras. *J. Urol.*, Balt., 55: 298.

Women with recurring attacks of frequency of urination and dysuria and usually without pathological evidence in the urine have in the past been subjected to complete urological and gynecological studies, but no satisfactory answer to the problem was obtained. The authors have undertaken a study to determine, if possible, what type of pathological change may be found in the routine female urethra that could possibly be an etiological factor in the production of these frequently unexplained urinary symptoms. They also attempted to determine the presence or absence of a prostatic gland in the female.

The entire urethra, bladder, and vagina were removed together from 100 consecutive cadavers. Eighty-six specimens were from adults and 14 from infants, 3 of whom were premature. The urethra was measured both for circumference and length prior to fixation. Following fixation, sections were made for microscopic study as follows: cross sections of the entire urethra in 24 cases; longitudinal sections of the entire urethra in 36 cases; and longitudinal sections of the posterior half of the urethra both in the midline and immediately lateral to the midline in 40 cases. In addition, the prostate and posterior urethra of 16 newly born, full term, and premature male infants were sectioned. Also, to compare the size of the posterior male urethra with that of the entire female urethra, measurements were taken of the prostatic urethra in 40 men who showed no hypertrophy of the prostate.

The belief of most embryologists that the female urethra is the homologue of the prostatic urethra of the male is supported by this study. The measurements of the entire female urethra and of the prostatic urethra of the male are strikingly similar. There is less agreement among anatomists regarding the presence or absence of glands in the posterior female urethra, and still less agreement as to whether or not these glands, if present, are homologues of the prostatic gland in the male. This study revealed glands present in every case in the anterior urethra and in 65 per cent of the posterior female urethras. These glands resembled microscopically some of the glands seen in the prostates of newly born and premature male infants.

None of the female urethras showed evidence of obstruction, but 76 per cent showed inflammatory reaction histologically. This reaction was confined most frequently to the mucosa and the submucosa. Nevertheless, this inflammation was present in 65.7 per cent of the cases without posterior urethral glands as compared with 56.9 per cent of the cases with glands.

Twenty-nine of the 76 patients showing inflammation had been catheterized before death, but the ratio between those having posterior glands and those having no glands in this group was about equal.

The cervixes were examined in all cases and showed no grossly apparent infection. Also, urethral inflammation was found in 4 of 15 full term female infants in whom cervical inflammation would be most unlikely.

The authors conclude, therefore, that the cause or causes of the urethral inflammations were not apparent. Posterior urethral glands, previous catheterization, or cervical inflammation did not appear to be a contributing factor. L. JAMES TUBOR, M.D.

Beato, V.: Functional Uterine Hemorrhages and Their Treatment with Testosterone (Las hemorragias uterinas funcionales y su tratamiento por la testosterona). *Rev. espan. obst.*, 1946, 3: 29.

In a previous communication (*Toko-Ginec. Prac.*, 1944, p. 465) the author discusses his experiences with testosterone in the case of myoma with bleeding, and claims to have preserved the reproductive capacity of many women, still young, by not subjecting them to hysterectomy or roentgen castration. He also includes cases of menorrhagia, metrorrhagia, and hemorrhage due to metropathy. He rejects the idea of treating the juvenile type of hemorrhage with testosterone because in young patients the possibility of a serious lesion in the tissues of the ovary has not been entirely disproved. Also in the mature woman he has resorted to the use of testosterone only exceptionally—in instances in which for some reason or another such treatment has been considered justifiable. Every day, however, more ample use is being made of this preparation in the functional type of hemorrhage which so often is observed to dominate the years of the climacterium and which is manifested principally in the guise of menorrhagias and metrorrhagias.

This hormone has been given by the author in a large number of cases of this nature; however, only 18 cases are the basis of this report. In these cases there has been a sufficient period of control to justify the author's speaking of the results of the treatment. In the majority of these cases the diagnosis was confirmed by histopathological examination of the endometrium, the specimen for study being procured by means of the streak curettement, or microcurettement (*Sirichabrasia* in German) before initiation of the treatment. In some instances also a biopsy was made after the treatment had been completed in an effort to demonstrate the changes in the endometrium as the result of the action of the testosterone and to seek the cause of the inhibitory effects on the hemorrhagic condition. These studies will be reported in a subsequent communication.

In 16 of the 18 patients the treatment was a complete success and in 2 a complete failure. Two possibilities are suggested as the reason for these failures: (1) the patients were among the early cases treated and the doses might have been too

# OBSTETRICS

## PREGNANCY AND ITS COMPLICATIONS

Kupperman, H. S., and Greenblatt, R. B.: The 2 Hour Pregnancy Test. *South. M. J.*, 1946, 39: 158.

A brief history of the tests employed to shorten the time necessary to make a diagnosis of pregnancy with no apparent sacrifice in accuracy is given. Utilizing the hyperemic effect of urinary gonadotropins upon the ovary, the authors have devised a pregnancy test with immature female rats which shortens the time necessary for completion of the test to 2 hours. Two cubic centimeters of concentrated urine are injected intraperitoneally into immature female rats weighing between 30 and 80 gm. and the animals are then sacrificed by ether asphyxiation in 2 hours. Hyperemia of the ovary and the ovarian capsule is indicative of a positive reaction. The accuracy of the test proved to be 99.5 per cent in a total of 752 tests performed on 1,346 rats. These figures exclude observations on 18 ectopic pregnancies in which a correct diagnosis was obtained in 83.3 per cent. Comparison of the rat test with the Friedman test in a series of 251 cases showed the rat test to be 100 per cent accurate in this series as compared to 97.3 per cent accuracy with the rabbit procedure.

Immature hamsters and adult female mice were found to be suitable for this type of test, provided the animals were sacrificed in 15 or more hours. Neither guinea pigs nor immature mice were adaptable to the test.

Observations on the hormone responsible for the positive end-point indicated that this reaction is due to luteinizing or luteotropic activity of the administered urine, and in the hands of these investigators, the normal menstrual cycle produced no false positive results. Among the emphasized advantages of this particular test are its accuracy, simplicity, availability of the test animal, and the short time required.

For, M. J., and Bortin, M. M.: Rubella in Pregnancy. *J. Am. Med. Ass.*, 1946, 130: 568.

This investigation of congenital malformations of the newborn of mothers who have had rubella during pregnancy is particularly worthy of note because it offers a more favorable prognosis for the infant than appeared justified from previous reports. The survey of the 3 year period reports rubella. Of this total 581 cases occurred from 1942 to 1944 women. The authors found it possible to investigate 152 or approximately 26 per cent of these married women. Eleven were pregnant at the time they had rubella. In 5 the disease occurred during the first 2 months of pregnancy, in 4 between the second and fourth months, in 1 a woman it occurred in the seventh month, and in 1 in the ninth month.

Of these 11 patients only 1 revealed a pathological course. This patient had rubella in the first month of pregnancy. The fetus was delivered, stillborn and hydrocephalic, 2 months before the expected date of confinement.

Others, in previous reports, have noted many congenital anomalies of infants born to mothers who have had rubella during pregnancy. Cataracts, heart disease, deaf-mutism, microcephaly, microphthalmus, atresia of the biliary ducts, and renal glomerulosclerosis have been reported. It has even been suggested by several that if a woman contracts rubella, particularly during the early months of pregnancy, a therapeutic abortion is indicated. These previous correlations and conclusions, however, have been based upon individual records, not attempt has been made to cite the number of women having rubella during pregnancy whose offspring had no congenital defects.

The present report does not justify the termination of pregnancy because of rubella. However, it does indicate the possibility of some relationship between congenital anomalies and this otherwise innocuous disease.

Waaler, E.: Acute Anterior Poliomyelitis Complicating Pregnancy. *Acta. med. scand.*, 1946, 123: 209.

The author poses a series of questions about acute anterior poliomyelitis complicating pregnancy. Does it run a more serious course in pregnancy? Does disease have any effect in pregnancy or labor? What is the frequency of the disease complicating pregnancy? Does it have any effect on the child or does intrauterine infection occur?

The author has collected 8 cases, in 2 of which the mother died and was examined at autopsy. He also reports on 25 cases found in the literature. He also that from his small series and the few cases reported in the literature, it is difficult to ascertain with great accuracy the answer to the stated questions.

The mortality of the 33 cases in the two series used was 8, or 24 per cent, whereas the general average is between 10 and 20 per cent. It may be assumed from this that the mortality is higher in pregnancy, but the author points out that only the more serious cases may have been reported. Also, among the cases occurring at Bergen in 1941, 1 of 7 pregnant women died and 4 of 16 nonpregnant women died. As to the occurrence of the disease in the various months of pregnancy and its relative severity, the author states the following: 3 cases occurred in the first 2 months, 10 in the third and fourth months, 5 in the fifth and sixth months, 9 in the seventh and eighth months, and 6 in the ninth month. The deaths followed a different pattern, none occurring in the first 4 months, 1 in the fifth and sixth months, 6 deaths occurring in the seventh and eighth months, and 3 in the ninth month. The author states that it

mitted to get up too soon. Bed rest and the application of ice to the abdomen are recommended for all cases. In the milder types, the administration of sulfonamides may prove sufficient. In moderately severe cases the authors recommend a vaccine-containing streptococci, staphylococci, and enterococci. This is injected daily or every other day, beginning with a dose of  $\frac{1}{4}$  c.c. and rapidly increasing it to 2 c.c. This vaccino-therapy is continued as long as the fever persists. In the most severe pyohemic cases, good results may be obtained by the intravenous drop infusion of alcoholized glucose serum.

EDITH SCHLANGE MOORE.

**Perelra, A. De S.: Abdominopelvic Sympathectomy for Relief of Pain of Cancer of the Cervix. *Arch. Surg.*, 1946, 52: 113.**

The relief of pain secondary to pelvic carcinoma by surgical therapy was first attempted by Jaboulay in 1889. Leriche, in 1921, introduced periaarterial sympathectomy of the hypogastric arteries, and Cotte in 1925 showed that pelvic pain may be relieved by interruption of the hypogastric plexus. Further studies of Leriche, Fontaine, Herrmann, Greenhill, Wetherell, Atlee, Fulcer, Cutler, and VerBruggen are briefly but adequately discussed in this article. Sousa started this study to clarify two problems:

1. The effect of abdominopelvic sympathectomy.
2. The merit of bilateral ligation of the hypogastric arteries.

The ligation was done to avoid the danger of hemorrhage from the ulcerated carcinoma of the cervix following sympathectomy which is known to increase the collateral circulation of the uterus after ligation of the hypogastric arteries. Different types of abdominopelvic sympathectomy were performed in order to determine their comparative values in the treatment of pain in inoperable cancer of the cervix uteri.

An attempt was also made to determine whether abdominopelvic sympathectomy "must or must not be followed by adequate physical therapy (radium and roentgen rays)."

The problem is complicated by the fact that the uterus derives its sympathetic nerve supply mainly from the hypogastric plexus, and secondarily from nerve fibers which accompany the hypogastric ves-

sels. Afferent sensory fibers conducting painful sensations from the uterus along the hypogastric and aortic plexus and through the lumbar sympathetic chains join to reach the spinal cord through the eleventh and twelfth thoracic nerves. The sensory fibers that accompany the hypogastric and common iliac vessels probably run through the lumbar sympathetic chain before they arrive at the spinal cord.

The technique used consisted of opening the abdomen by a median subumbilical incision. Careful and complete examination of the pelvis determines the extent of invasion of the tumor. Abdominopelvic sympathectomy to relieve pain is planned according to the finding in each case. The peritoneum is incised beginning just below the inferior mesenteric artery and down beyond the bifurcation of the aorta, with a Y-shaped incision over the course of the right and left common iliac arteries to a point beyond the origin of the hypogastric arteries. Then, the hypogastric plexus, the lower part of the aortic plexus, and the lumbar sympathetic chains may be resected. This operation completely interrupts the hypogastric afferent pathways from the pelvic organs; but it is also necessary to interrupt the afferent pathways that follow the vessels, particularly the arteries. For this reason, periaarterial sympathectomy of the common iliac arteries and sympathectomy of the inferior mesenteric artery are required to complete the interruption of the afferent pathways from the pelvis.

In all cases, after abdominopelvic sympathectomy, ligation of the hypogastric arteries was always done.

A total of 14 patients comprise the author's material. In 7 the operation was limited to resection of the hypogastric plexus. In the last 7, the operation was extended to interrupt additional sympathetic pathways. None of the patients died from hemorrhage. The results were improved when the radium was applied during the period of increased blood supply caused by the vasodilatation following the sympathetic operation. Visceral sympathetic pain was absent as long as the carcinoma remained within the anesthetized area, but when the carcinoma progressed and invaded the lumbosacral plexus, pain which radiated down the lower extremities manifested itself.

SAMUEL J. FOGELSON, M.D.

the uterus as in the Kristeller maneuver, thus delivering the arms and shoulders. The lordosis is now exaggerated by carrying the buttocks over the abdomen of the mother; the chin and then the mouth appear and, finally, the head is delivered in deflexion.

In 26 patients with pelvic presentation Bracht's maneuver was employed. In 1 case there were twins and the second child was delivered in cephalic presentation. Sixteen of these mothers were primiparas, 3 being 32, 36, and 37 years of age, respectively; 2 were secundiparas, and the remaining 8 were multiparas. Twenty of the deliveries were at term and 6 took place when the pregnancy was between 8 and 8½ months. Nine of the infants weighed from 2,000 to 3,000 gm.; 14 weighed from 3,000 to 4,000 gm., and 1 weighed 4,340 gm. Twenty-three of the deliveries were from incomplete pelvis and the remaining 3 from complete pelvis.

In 23 of the entire 26 mothers treated by Bracht's maneuver, the labor was perfectly successful (88.4 per cent). In 1 of the 3 women whose labor course was considered a partial failure, one arm had to be brought down manually; however the remainder of the course was perfectly normal, giving a true percentage of success of 92. Of the remaining 2 unsuccessful deliveries in which the child had to be extracted, one infant proved to be a mongoloid with marked edematous swelling about the neck and throat; no explanation—except, possibly, inexperience of the operators—could be adduced for the failure in the remaining case. In 1 instance proclivencia of the cord took place; however, it was not interfered with, the delivery of the child taking place almost immediately, and at no time did the pulsation of the cord indicate any inconvenience on the part of the fetus.

The delivery of the head deflexion and the inability of the operator to guard the perineum personally seems to be a disadvantage of the Mariceau maneuver, and in the author's material this has resulted in a rather high percentage of perineal ruptures (18 per cent in primiparas and 19 per cent in the entire material). The author believes this should be countered by limiting as much as possible the expulsive (Kristeller) pressure exercised suprapubically by the assistant on the after coming head and by extending the use of episiotomy. However, it is not to be assumed that the deflected position of the head during delivery is more than normal. It is considered that in the Mariceau maneuver the flexion of the head is exaggerated, but it is rather a relative condition, incidental to the exaggerated lordosis of the infant's body. The author is unable to substantiate this opinion, however, and suggests that x-ray studies of the passage of the fetal head through the maternal pelvis be made.

A lengthy theoretical discussion of the entire process of labor in breech presentation, including the author's ideas as to why the Bracht maneuver seemed to be somewhat more successful in incomplete than in complete pelvic mechanisms, could not be abstracted.

JOHN W. BRENNAN, M.D.

Mitchell, R. M.: Forceps for Delivery—Their Use and Abuse. *Surg. Clin. N. America*, 1945, 25: 1436.

This article presents a review on the proper use of forceps, with a warning that misuse of the instrument will lead to many fetal and maternal injuries. The first portion of the article outlines the fundamental principles of obstetric forceps, which are:—

- (1) Knowledge of the instrument
- (2) Function of the forceps—this is divided into the four major functions of the forceps
  - a. Traction
  - b. Rotation
  - c. Leverage
  - d. Compression
- (3) Classical applications
  - a. Pelvic
  - b. Cephalic
  - c. Cephalopelvic
- (4) Principles of application
  - a. The law of the forceps
  - b. The rule of the forceps
- (5) Indications for the use of forceps
  - a. Maternal
    1. Insufficiency of the powers
    2. Rigid perineum
    3. Large baby
    4. Inability to bear down
    5. Maternal exhaustion
    6. Previous cesarean section
    7. Toxemia of pregnancy
    8. Pulmonary disease
    9. Cardiac disease
    10. Renal disease
    11. Premature separation of placenta
    12. Marginal placenta previa
  - b. Fetal
    1. Intrauterine asphyxia
    2. Abnormal presentation
    3. Prematurity
    4. Prolapsed cord
- (6) Conditions for the use of forceps
  - a. Surgical asepsis
  - b. Empty bladder and rectum
  - c. Knowledge of fetal position
  - d. Complete effacement and dilatation of cervix
  - e. Ruptured membranes
  - f. Absence of disproportion
  - g. Live baby
  - h. Station of the baby

The remainder of the article is devoted to detailed description of the various forceps operations in an outline form in which all the "do's" and "don't's" are carefully emphasized.

JAMES F. DONNELLY, M.D.

#### PUERPERIUM AND ITS COMPLICATIONS

Douglas, R. G., and Davis, I. F.: Puerperal Infection. *Am. J. Obst.*, 1946, 51: 352.

Evidence has been presented indicating a decreased mortality from puerperal infection in the



would seem that the prognosis for mothers contracting this disease in the last months of pregnancy is bad.

The author believes that, at least from his series of cases, poliomyelitis does not cause, nor increase the frequency of, complications of pregnancy or labor.

In comparing his series with 2 other reported series, the author believes that the frequency of the disease is greater in pregnant women, but states conservatively that the series were small.

As to the action of poliomyelitis on the fetus and child, the author reports that all of the live infants showed no evidence of the disease and all were well at the end of 3 years. Microscopic study of sections of the nervous system of the 2 women who died revealed no evidence of transmission to the fetus.

BYFORD F. HESKETT, M.D.

**Dana, E. S.: Premature Delivery; Causes and Results.** *Am. J. Obst.*, 1946, 51: 329.

A series of 941 cases of premature delivery at the author's clinic was studied. The incidence of prematurity was found to be 2.95 per cent. The causes of premature labor and delivery were classified as maternal, fetal, and placental. The obstetric factors in premature deliveries were discussed. The incidence of operative delivery in this group was 27.9 per cent. The gross infantile mortality was 33.3 per cent. The corrected infantile mortality was 18.8 per cent. Both gross and corrected infantile mortality rates have shown a steady decline in the past 10 years.

It was concluded that the causes of premature delivery are, in many cases, beyond the control of the obstetrician. His role in the prevention of prematurity consists in the control of syphilis and febrile diseases, and in continued research on the toxemias of pregnancy.

The obstetric management at the time of delivery was found to affect the infantile mortality. It was shown that spontaneous or low forceps deliveries were the procedure of choice. The use of episiotomy was found to be of value. Morphine as an analgesic agent was contraindicated. The availability of prompt oxygen therapy and expert pediatric care is of prime importance. EDWARD L. CORNELL, M.D.

**Burthiault, R., and Sournia, J.: Genital Infarcts after Abortion** (*Les infarctus genitaux post-abortum*). *Lyon chir.*, 1945, 40: 347.

Infarction of the uterus and/or the ovary coinciding with an abortion is a rare occurrence; only 55 cases are on record in the entire literature.

As to the etiology, opinions differ, and it is difficult to decide if this complication occurs more often in spontaneous or in induced abortion. Although genital infarcts have been observed in the absence of pregnancy, in most instances criminal manipulations have been either proved or suspected. Especially the intrauterine injection of soap solution seems to play a fatal role in many cases.

The symptoms are those of an acute generalized peritonitis. The uterus is much larger than would correspond to the stage of pregnancy; it is very hard and gives the impression of being wooden. A very important sign is the blue or blackish discoloration of the cervix, either in toto or in part. As this sign has often been observed in the early stages, the authors stress that the vaginal examination with the speculum should never be omitted. Only an early diagnosis can save the life of the patient, and even gangrene of the cervix may be found at a time when the corpus is still intact.

The treatment is immediate hysterectomy. The prognosis is very serious; of the 55 cases on record, 32 ended fatally, usually because of shock or progressive intoxication.

The authors give 2 case histories of infarction after abortion in the fourth month of pregnancy. Both ended fatally. WERNER M. SOLMITZ, M.D.

## LABOR AND ITS COMPLICATIONS

**Baldi, E. M.: Our Experience with Bracht's Maneuver in Delivery in Cases of Pelvic Presentation** (*Nuestra experiencia con la maniobra de Bracht en la atención del parto en presentación pelviana*). *An. Inst. maternidad*, 1944, 6: 29.

Of a series of 51 cases of delivery with pelvic presentation Baldi found in 86.3 per cent that Bracht's maneuver was effective. The simplicity as well as the freedom from infection of this operation, as there is no need to introduce the hand into the birth canal, leads the author to recommend this procedure for tocological practice. WILLIAM E. RUCKETTS, M.D.

**Nieva, M. R.: The Bracht Maneuver in the Delivery of Pelvic Presentations** (*La maniobra de Bracht en la atención del parto en presentación pelviana*). *An. Ateneo Inst. maternidad*, 1945, p. 101.

Bracht maintains that the classic method of delivering the child in pelvic presentation, instead of favoring, actually perturbs the physiologic mechanism, if one accepts the interpretation of Sellheim. This author taught that, once the buttocks had been born, the fetus rotates so as to place the dorsum toward the front, which causes the shoulders to become engaged in the transverse diameter of the pelvis. The pelvic pole is lifted anteriorly, which produces a lordosis of the trunk and thus executes a motion of rotation about the symphysis pubis. This movement, however, promptly terminates as the force of gravity causes the body of the infant to fall down between the thighs of the parturient woman.

In the Bracht method this opposition of the force of gravity to the movement of rotation about the symphysis is opposed manually. This is accomplished in the following manner:

After expulsion of the pelvic pole the accoucheur waits until the points of the scapulae appear and then grasps the buttocks and thighs with both hands and lifts the fetus without exerting traction. At the same moment an assistant exerts pressure on the body of

the uterus as in the Kristeller maneuver, thus delivering the arms and shoulders. The lordosis is now exaggerated by carrying the buttocks over the abdomen of the mother; the chin and then the mouth appear and, finally, the head is delivered in deflexion.

In 26 patients with pelvic presentation Bracht's maneuver was employed. In 1 case there were twins and the second child was delivered in cephalic presentation. Sixteen of these mothers were primiparas, 3 being 32, 36, and 37 years of age, respectively; 2 were secundiparas, and the remaining 8 were multiparas. Twenty of the deliveries were at term and 6 took place when the pregnancy was between 8 and 8½ months. Nine of the infants weighed from 2,000 to 3,000 gm.; 14 weighed from 3,000 to 4,000 gm., and 1 weighed 4,340 gm. Twenty-three of the deliveries were from incomplete pelvises and the remaining 3 from complete pelvises.

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JAMES F. DONNELLY, M.D.

## PURPERIUM AND ITS COMPLICATIONS

Douglas, R. G., and Davis, I. F.: *Puerperal Infection. Am. J. Obst., 1946, 51: 352.*

Evidence has been presented indicating a decreased mortality from puerperal infection in the

United States, amounting to approximately 50 per cent during recent years, as compared to previous experience. However, in New York, these rates remain essentially the same, despite a decrease in the total maternal mortality during the past decade to one-third of the former rate. In the New York Lying-In Hospital both the incidence of puerperal infection and the mortality associated with this condition have shown a progressive and very significant decrease.

The bacteriologic data obtained from the study of 1,000 patients subjected to investigation is presented in tabular form. It indicates that the great majority of infections occurring during the puerperium and postabortal period are endogenous in origin, and caused for the most part by different groups of nonhemolytic streptococci.

An analysis of underlying conditions responsible for the development of infection, such as hemorrhage, anemia, prolonged labor, cesarean section, and other operative procedures, is shown graphically.

Prophylaxis of infection is shown to be far more important than the treatment of the disease once established. Measures aimed at the prevention of exogenous infections and their successful employment are illustrated. Prevention of endogenous infections is discussed in more detail, including methods of avoiding underlying causes as well as actual prevention of the invasion of organisms when unavoidable situations arise.

It is the authors' opinion, based on experience but not proved conclusively, that sulfadiazine, given early during long labors and under certain other circumstances, will decrease the incidence of infection. Sulfadiazine or penicillin given early may be efficacious, while when given late in the course of the disease it may be relatively ineffective.

EDWARD L. CORNELL, M.D.

### NEWBORN

Beck, A. C.: The Obstetrician's Responsibility for the Hazards of the First Few Days of Life, with Special Reference to Anoxia and Prematurity. *Am. J. Obst.*, 1946, 51: 173.

In the 5 year period from 1940 through 1944, 7,580 infants weighing 1,000 gm. or more were born at the Long Island College Hospital, Brooklyn, New York. Twelve, or 1 in 631, of the mothers died. During this period, 99, or 1.3 per cent, of the infants were born dead and 101, or 1.33 per cent, died while in the hospital. Congenital anomalies were responsible for 32.6 per cent of 101 neonatal deaths. Nine and nine-tenths per cent were due to infection. Brain hemorrhage was demonstrated in 14.8 per cent, while the remainder of the dead infants, or 41.5 per cent, showed nothing more than congenital atelectasis when autopsy was permitted. In the last group of infants, respiratory symptoms had almost invariably been present, and most of the deaths in this group were preceded by periods of intermittent cyanosis. These respiratory symptoms were the

same as those which are present when tentorial tears and injuries of the brain are demonstrable at autopsy; therefore, the brain has been injured also.

The effect of a diminished oxygen supply, both in the mother and in the fetus, is discussed. The mortality from breech delivery of the infants weighing from 1,500 to 2,000 gm. was 50 per cent, or almost two and one-half times the mortality of the series of infants of the same weight. It was only among the larger infants, which weighed more than 2,000 gm., that the mortality of breech delivery approached that of the series. Spontaneous delivery with episiotomy done under local anesthesia was shown to be the safest method of delivery for the premature infant.

If the 9 cases in which cesarean section was done for placenta previa and the 2 in which the child died as a result of congenital anomalies are deducted from the 39 cases of cesarean sections, there remain 28 cases undergoing operation with 2 deaths, a premature infant mortality of 7 per cent. Therefore, cesarean section is at times a valuable method of delivery.

EDWARD L. CORNELL, M.D.

### MISCELLANEOUS

Thomas, R. C.: Results in 18,600 Booked Deliveries. *Lancet*, Lond., 1946, 1: 101.

The plan under which the Borough of Croydon's obstetric service operates is discussed by the author and is offered as a model after which similar services might be instituted in other boroughs comprising a population up to 250,000 persons.

The entire service is supervised by a single obstetrician whose duty it is to integrate the work of all midwives and obstetricians in providing ideal antenatal, natal, and postnatal care for all. Home as well as hospital deliveries are included in the scope of the plan, and complicated home deliveries are aided by the work of a so-called "emergency flying squad" which renders resuscitative measures and provides for immediate hospitalization.

A statistical analysis of 18,632 booked deliveries after the twenty-eighth week under the above plan encompassing an 8 year period is given. Altogether, 18,822 infants, including 190 sets of twins were delivered. Three mothers died undelivered and 14 died after delivery. The deaths are classified as follows: directly due to pregnancy, 0.53; associated with pregnancy, 0.37; and a total (all causes) of 0.9 per 1,000 total births. The stillbirth rate was 2.1 per 1,000 total births, and the infant death rate, 15.1 per 1,000 live births. JAMES F. DONNELLY, M.D.

Goodwin, M. S., and Moore, J. E.: Prenatal Syphilis. *J. Am. M. Ass.*, 1946, 130: 688.

The authors have analyzed a series of 57 pregnant women with early syphilis treated with penicillin (31 from their own clinic and 26 previously reported by Ingraham et al.). Patients with early syphilis were purposely selected to test the efficacy of penicillin in the prevention of infantile congenital syphilis.

in that group of cases in which the probability of infection of the fetus was greatest. Fourteen mothers were treated before the sixteenth week of gestation; treatment was given to 31 between the sixteenth and thirty-second week, and the duration of pregnancy in 12 was 32 weeks or longer when treatment was begun.

Of the 57 patients, only 2 had received previous antisyphilitic treatment, and in both instances the circumstances of the previous treatment was such that they could be considered cases of early syphilis. One was apparently reinfected during pregnancy following a symptom free, seronegative period, and the other was a reinfection of cured congenital syphilis.

The total dosage range of the single courses of treatment in both groups was comparable, the majority of the patients having received from 1.2 to 2.4 million units of penicillin. Of the 57 patients, 5 were re-treated during pregnancy because of serologic relapse. In each of these 5 instances, the babies were born alive and apparently normal. Two mothers had a clinical relapse—one, whose infant was the only one in the series to develop congenital syphilis at term, and the other 4 weeks postpartum. The serologic response in general tended to revert toward

negativity at the same rate in pregnancy as in males or nonpregnant females.

Of the 61 babies delivered from these 57 mothers, only 1 developed congenital syphilis during the period of observation; 49 of the remainder were followed up for more than 2 months, and 18 of these who were seropositive at birth had become seronegative.

One hundred and fifty cases were given intensive arsenotherapy with a resultant failure rate of 15 per cent while of the 60 infants delivered of the 57 women treated with penicillin only 1 child was syphilitic—a failure rate of 1.6 per cent. Furthermore, with penicillin the results were equally good no matter what the duration of pregnancy at the time treatment was begun, which contrasts to a failure rate of from 5 to 50 per cent from metal chemotherapy, according to the stage of pregnancy when therapy was instituted.

Statistically, it did not appear that penicillin was directly or indirectly responsible for abortion.

On the basis of this report, the authors recommend that in syphilitic pregnant females, penicillin be used routinely for the prevention of neonatal syphilis, and that other methods of therapy be abandoned.

JAMES F. DONNELLY, M.D.

# GENITOURINARY SURGERY

## ADRENAL, KIDNEY, AND URETER

Kittredge, W. E., and Brown, H. G.: The Present Status of Unilateral Renal Hypertension. *J. Urol.*, Balt., 1946, 55: 213.

Following Goldblatt's work on renal ischemia as a factor in producing hypertension, attention was directed to unilateral renal disease as a cause of hypertension. Further experimental and clinical research suggested that the development of hypertension in these cases was of humoral rather than of neurogenic origin. However, the exact etiological basis for unilateral renal hypertension is still speculative.

Search for a characteristic microscopic appearance of the kidney pathology in cases of unilateral renal hypertension has been fruitless. It is to be noted that the Goldblatt kidney does not show arteriosclerotic changes until renal insufficiency has developed. Furthermore, even when hypertension is produced by a unilateral renal lesion, it can cause irreversible vascular changes in the opposite kidney, which changes in themselves are capable of continuing the hypertensive disease.

The clinical application of much of the research findings to the treatment of unilateral renal hypertension in the human subject would be facilitated if there were a clinical picture characteristic of unilateral renal hypertension. In an effort to bridge this gap, the following suggestions have been advanced:

1. Ravitch suggested that certain anatomic peculiarities of the kidney be used, e.g., the intra-renal type of pelvis when influenced by even mild pathological conditions might result in hypertension by constricting the renal artery. This has not been confirmed by other investigators.

2. Flocks believes the most important consideration in selecting cases for nephrectomy is relative renal ischemia in the kidney in question; this is recognizable by a comparison of the total renal mass, seen in the roentgenogram, with the differential pthalein function of the kidney. Reduction in renal function without commensurate reduction in the cortical renal mass is considered evidence of relative ischemia and is thought to represent the most favorable case for nephrectomy. However, in experimental unilateral renal hypertension, there may not be any demonstrable variation from the normal anatomic structure or function of the kidney.

In an evaluation of the end results of nephrectomies done to relieve unilateral renal hypertension, among the factors to be considered is a realization that:

1. An accurate evaluation of results is impossible before a year has elapsed after operation, because

- a. The temporary fall in blood pressure following surgery may be due to enforced bed rest

and change in the mode of living, or even to the removal of toxicity in infected cases.

- b. This fall may last for months before hypertension recurs, although symptomatic relief may continue. In some cases, as much as a year elapsed before hypertension reappeared.

2. No permanent change in the blood pressure can be reasonably expected to follow the removal of a functionless kidney, regardless of whether or not the diseased kidney was the original cause of the hypertension. In either case the presence of the hypertension may have caused irreversible arteriolar changes in the opposite kidney.

3. The incidence of hypertension in a series of patients with unilateral kidney disease is actually no greater than the incidence in any other group of patients of comparable age, chosen at random.

In a recapitulation by the authors, of Mayo Clinic experience, it was reported that the renal lesion most often associated with hypertension, which was most amenable to surgical treatment, was atrophic pyelonephritis. It was also noted that the severity of the atrophy was in direct proportion to the incidence of hypertension. The incidence of hypertension was low in pyelonephritis without atrophy and sclerosis. Acute cortical infections were seldom, if ever, the cause of hypertension. The next most common lesion associated with hypertension in the Mayo Clinic series was renal neoplasm, followed in order by renal lithiasis, hydronephrosis, tuberculosis, and polycystic kidneys. In cases of renal lithiasis, it was found that the role of infection was important, since hypertension occurred in 25 per cent of the cases in which infection was present, and in only 5.7 per cent of those in which there was no infection. The deciding factor, however, was not the degree of infection but the presence of extensive vascular sclerosis and parenchymal atrophy. A followup study of the patients with hypertension who were operated on showed that hypertension was relieved in 70 per cent of the cases of pyelonephritis, in 50 per cent of those with tuberculosis, and in 25 per cent of those with renal stone, hydronephrosis, or tumor.

The point is also made that previous conservative operations on the kidney or actual renal trauma may cause unilateral hypertension in some cases; if hypertension should develop later, unexplained on any other basis, nephrectomy is probably indicated.

In all the cases of unilateral renal hypertension treated by the authors at the Ochsner Clinic, it was their custom to do a unilateral splachnicectomy at the time nephrectomy was done, in order to have that much accomplished in the event that a bilateral splachnicectomy should be considered desirable later. Unilateral splachnicectomy does not produce a beneficial effect on hypertension, and therefore, does not influence whatever result is obtained from nephrectomy.

Included are 4 case reports by the authors, illustrative of some of the various considerations discussed.

EUGENE J. AUDI, M.D.

**Burford, C. E.: Nephroptosis with Coexisting Lesions. *J. Urol.*, Balt., 1946, 55: 220.**

The too obvious cause of disabling pain in several of the author's patients led to a reattempt at nephropexy with gratifying results, which seem both to revive and to place on a new basis this formerly discredited operation.

A new feature was the more exact diagnosis. The cystoscopic roentgenographic combination table makes it possible to secure pyeloureterograms in both recumbent and upright positions, and thereby visualize the cause of pain, and also visualize any destructive processes in cases of nephroptosis. The operative procedure corrected the difficulties encountered in obtaining proper drainage through the ureteropelvic juncture and a properly functioning ureter.

A brief presentation of the clinical picture of nephroptosis includes:

**Causes.** These are asthenia, debilitating diseases, childbirth, and trauma from falls or blows.

**Symptoms.** Usually the first is pain, coming on after the patient is tired or on the feet for long periods. The pain may be in the posterior fossa under the twelfth rib or on either side of the abdomen, radiating to the genitals and urethra. It is usually due to retention of only a few cubic centimeters of urine in the kidney pelvis. The second most common symptom and one which usually accompanies the first is nausea, with or without vomiting. Occasionally the patient merely complains of anorexia with consequent loss of weight.

**Body build.** Some marked cases of nephroptosis are found in obese patients; the majority of psoed kidneys, however, occur in thin patients who have lost weight and have relaxed abdominal walls.

**Complications.** Often the kidney is only a part of a splanchnoptosis, and if the position of the kidney and ureter causes urinary stasis with hydronephrosis, infection and stone formation frequently follow.

In arriving at a decision as to whether operative interference is indicated, it is not sufficient to say that there is a low or movable kidney. Kidneys which can be palpated at the level of the pelvic brim are often asymptomatic and function normally. A complete urological examination is necessary with careful interpretation of the findings before it can be decided that nephropexy will relieve the patient's symptoms and stop the destructive process in the kidney itself.

The cystoscopic examination must take note of any obstruction encountered in either ureter; aspiration of each ureteral catheter must be done after it has reached the kidney pelvis to determine the residual urine; a phtalein function test (intravenous) should be made; and the time of appearance of the drug from each kidney and the concentration

for at least 10 minutes should be noted. A flat plate of the abdomen is made to determine whether stones are present, and this is followed by bilateral pyelograms with the patient in the horizontal position and with the lungs in expiration. Overdistention of the pelvis, resulting in the production of colic, must be avoided. Another pyelogram is taken with the patient in a semisitting position and during held deep inspiration; this last film will visualize any kinks in the upper ureter, produced by the descent of the 2 kidneys, and any constrictions at the ureteropel junction.

If stones are found in the kidney or ureter, they are removed during operation for nephropexy. Chronic infection in the kidney pelvis is not considered a contraindication to operation. Stasis of urine and infection in the kidney pelvis may be cleared up in some instances only by nephropexy and the necessary plastic surgery on the kidney pelvis and ureter.

Generally, the operative technique of Kelly is followed, in addition to which the upper portion of the ureter is exposed and carefully freed from all adhesions and anomalous vessels which might interfere with free peristalsis. These bands or fibers may not appear to constrict, but may run parallel with the ureter as an integral part of its external structure. However, they rob the ureter of its elasticity and prevent proper peristalsis, and they must be dissected away. Most of the lesions which cause destructive hydronephrosis in cases of nephroptosis are located at the ureteropelvic juncture and are made worse by the kidney's low position which causes an increase in the angulation of the ureter at this point. The general rules formulated from the author's experience in attempting the plastic procedures necessary in each case, to secure good functional drainage, are: ablate excess pelvic tissue in a manner that will leave the ureter draining from the lowest portion. If there is a constriction or ring of fibrous tissue, a Y-plasty is done and splinted with an indwelling catheter. Small aberrant vessels, crossing the pelvis to the lower pole, are ligated and cut. If, on compression, these vessels appear to supply as much as one-third of the kidney, the ureter is reimplanted in the lowest portion of the pelvis, at a point where it will not be constricted, instead of sacrificing the circulation of the kidney.

If there is a stone in the kidney, it is removed through a pelvic incision or by nephrotomy and the kidney is drained through its substance rather than through the pelvis. An infected hydronephrosis is drained in the same manner.

The last step is the suturing of the kidney in a high yet natural position so that the ureter will be straight but not taut. In clean cases, medium sized silk is the suture of choice, while No. 1, 20 day catgut is used when infection is present. The capsule is left intact because it makes a firmer hold for the sutures and avoids the formation of a sclerosing shell to constrict the circulation at a later date. Kelly's three point stitch in the capsule has proved most

satisfactory, the upper suture being brought out and tied in the intercostal muscles between the eleventh and twelfth ribs. The other two are taken in the muscles and fascia in the back under the twelfth rib. Care must be taken not to rotate the kidney out of the plane of its normal position. Postoperatively, the patient is kept flat in bed for 2 weeks, then gradually allowed out of bed over a period of about 17 days. In the author's experience in more than 200 nephropexies, there has never been occasion to reoperate because of failure of kidney suspension. In about 6 cases, operated on later because of additional renal disease, all the previously suspended kidneys were found firmly fixed.

The conclusions reported are similar to those made when the author reported his first 48 cases in February, 1927, although much improvement has been made on the plastic procedures at the ureteropelvic junction.

EUGENE J. AUDI, M.D.

**Dorman, H. N., and Fowler, H. A.: Hemangioma of the Kidney.** *J. Urol.*, Balt., 1946, 55: 348.

A case of hemangioma of the kidney is reported with a review of the literature.

Hemangiomas are rarely encountered in the kidney. The number of cases so far recorded probably does not exceed 50, including both autopsy specimens and clinical cases. These tumors rarely attain a large size; they may be situated in any portion of the kidney. They are, however, usually small, and the tip of a papilla of the kidney is their favorite location.

In general, benign tumors of the kidney are asymptomatic, presenting symptoms due to pressure only when of unusual size. In contrast, hemangiomas and papillomas of the renal pelvis, both benign, produce symptoms—hematuria—at times so urgent as to demand prompt surgical interference as a life-saving measure. The hematuria, usually unaccompanied by severe subjective symptoms, is of sudden onset and commonly intermittent. The interval may vary from days to years. Further study reveals that the bleeding is unilateral. Pycelographic study is usually inconclusive. The only filling defect may be that of a large blood clot in the renal pelvis. The diagnosis is usually not made before operation, but after pathological study of the lesion.

The authors believe that the diagnosis of essential hematuria is meaningless and unsatisfactory in cases of intermittent hematuria which are unilateral in type and moderate in severity. Every such case if studied extensively enough will reveal some underlying pathological condition sufficient to explain the bleeding. If the urinary abnormalities associated with nephritis are absent, and if upon exhaustive study no probable cause is demonstrable, one should think of lesions of a renal papilla, the most serious of which is angioma.

In the majority of the cases nephrectomy has been performed as an emergency measure to save the patient's life. Bisection of the kidney for adequate exploration is only to be condemned because of the

high mortality and the resulting damage to the kidney structure and its functions. Nephrectomy should not be performed until conservative measures have been employed, such as the use of vitamin K, whole blood transfusion, and lavage of the renal pelvis with silver nitrate.

FREDERICK R. LIEBERTHAL, M.D.

**Kretschmer, H. L.: Bilateral Primary Sarcoma of the Kidney. Report of a Case and Review of the Literature.** *Q. Bull. Northwest. M. Sch.*, 1946, 20: 77.

The author reviews the case of an individual who suffered a bilateral renal sarcoma, this being the thirty-ninth such case recorded in the literature.

The patient was a 56 year old white male who originally complained of lassitude, anorexia, and fatigue. The first physician called found a distinct pyuria. Intravenous pycelography revealed a nonfunctional left kidney; the remainder of the urinary tract was normal except for the spider web deformity of the right calyces, and the left renal pelvis showed evidence of obstruction with dilatation of the calyces. The last may have been due to a questionable shadow in the left ureteral region suggestive of calculus of the size of a wheat grain in the upper ureter. The prostatic secretion demonstrated a few pus cells and there was found a residual urine of 45 c.c. with a great amount of pus.

Cystoscopic examinations revealed a trabeculated bladder and the presence of a posterior commissure, along with a ureteral stricture on the left side which was finally traversed by a ureteral catheter. The urine from the right kidney was normal while that from the left contained pus and the *Escherichia coli*.

Eighteen months later the patient complained of strangury, dysuria, dribbling, frequency, and nocturia. Renal function was markedly impaired, and after preparation the median commissure was resected. After operation the renal function was found to be unimproved with the nonprotein nitrogen at 200 mgm. per 100 c.c. the day before discharge. On this day neither kidney was palpable as compared to the findings when the patient was first seen, at which time the left kidney was palpable. This was believed to be due to hydronephrosis following the visualization of a shadow that was seen in the path of the upper left ureter and of a stricture of the same ureter, which was finally traversed with a ureteral catheter and dilated.

Five months after hospitalization the patient returned to the hospital complaining of weakness, anorexia, constipation, and loss of weight, but without symptoms. At this time both kidneys were palpable and the diagnosis of bilateral renal tumor was entertained. The patient soon died of uremia, and at autopsy there was found a bilateral lymphosarcoma of the kidneys with involvement of the periaortic lymph glands and metastatic lesions to the spleen.

The kidneys weighed 4,100 gm. and 68 per cent of the parenchyma of both kidneys was replaced by

a soft grayish tumor mass; this same type of tumor mass was present in the spleen. Microscopically, the renal parenchyma varied from the best preserved portions with arteriolar thickening and hyperemia to complete disappearance and replacement with lymphosarcomatous tissue.

The author briefly summarizes the literature on bilateral renal tumors other than sarcomas and tabulates various types of these tumors reported in the literature. The following gives an idea of the number of bilateral cases reported: carcinoma, 9; hypernephroma, 13; Wilms' tumor, 13; and miscellaneous bilateral renal tumors in 2 instances (cancer on one side with hypernephroma on the other, and sarcoma on one side and hypernephroma on the other). The author thus gathered a total of 77 cases of bilateral renal tumors from the literature.

ROBERT LICH, JR., M.D.

Villa, J. M. J.: A Study of Urethral Strictures of the Ureter and Their Complications (Estudio de las estrecheces tuberculosas del ureter y sus complicaciones). *Arch. espan. urol.*, 1946, 2: 301.

The majority of authors agree that tuberculosis of the excretory ducts of the kidney is secondary to renal tuberculosis.

Tuberculous lesions of the ureter may be superficial and limited to the mucosa, or deep, invading the entire thickness of the wall. Superficial lesions appear in the form of granulations or ulcerations, while the deep lesions are usually confluent, extensive, and either circumscribed or diffuse. A total caseous necrosis or regression with partial cicatrization of the ureter may occur. Elimination of the caseous necrotic sheath takes place gradually and is accompanied by an increasing periureteral sclerosis. If regressive processes predominate, tuberculous formations may disappear completely and newly formed embryonal tissue completely and the ulceration and organization.

A stenosis of the affected portion of the ureter leads to dilatation of the proximal fragment. Such stenosis may be caused by a massive infiltration of the ureteral wall, caseous formations, or fibrous cicatricial tissue. Adhesions between the involved portion of the ureter and adjoining organs, such as the psoas muscle, spermatic vessels, seminal vesicle, and iliac blood vessels, may develop. As a result of complete obstruction of the ureter a pyonephrosis or an enormous enlargement of the kidney may result.

An infection may spread from the kidney to the ureter either by contiguity or through the urine, blood, or lymph.

Clinically, tuberculosis of the ureter causes urinary symptoms and lumbar pains. Increased frequency of micturition, nocturia, hematuria detectable macroscopically or microscopically, a smarting sensation at the end of urination, and pyuria are frequent symptoms. The lumbar pains may appear in the form of the characteristic kidney colic or in the form of localized pains not influenced by movements of the body.

Cystoscopic examination is very valuable for the diagnosis. Asymmetry of the trigonum, caused by a shortening of the tuberculous ureter, and also Fullerton's sign justify the suspicion of a tuberculous ureter. Urography is also an important diagnostic aid.

The treatment of tuberculous strictures of the ureter is the same as that for renal tuberculosis, namely nephrectomy. No faith should be placed in spontaneous cure.

JOSEPH K. NARAT, M.D.

## BLADDER, URETHRA, AND PENIS

Pulvert Gorro, A.: Diverticulum of the Bladder. A Contribution to the Diagnosis and Treatment (Diverticulos vesicales. Aportación a su diagnóstico y tratamiento). *Arch. espan. urol.*, 1946, 2: 263.

In examining the bladder diverticulum it is well to use a cystoscope at an angle of 135 degrees, so that the tip of the instrument can be seen in the field of vision. In addition there should always be an extrography ureteropyelography and, finally, a vesiculography with iodized oil (Abelló), the occasion being utilized, especially in older patients, to interrupt the ductus deferens operatively in anticipation of a possible postoperative epididymitis later.

For the operation of extirpation of a possible diverticulum the author employs the extraperitoneal, extravesicular approach to the bladder; this is quite easy through a midline suprapubic incision for diverticulum of the anterior bladder wall, or through a lateral abdominal incision for the laterally located diverticulum. However, when the sac originates from the posterior wall the peritoneal covering must be separated from the bladder; this can be done by covering through a blunt separation of the peritoneal collapsed, with removal by means of the bladder the outermost layer of the muscular wall of the bladder over the area (about the size of a dollar) where the peritoneal covering is most firmly adherent. In some instances a breach may have to be made in the peritoneal sac, the adherent area left attached to the bladder and the peritoneal sac separated immediately closed again with sutures according to the method described by Voelcker (*Urologische Operationslehre*, 1924: p. 376). The bladder of filling is controlled by the urethral sound. The degree from the operator's hand on the bladder or on the diverticulum itself, and the diverticular sac is separated from its bed. Particular care must be taken in the region of the ductus deferens—which is apt to be displaced—and in the region of the ureter, when the neck of the sac takes origin down close to the base of the bladder, as this structure is apt to be involved in adhesions. Particular care must also be taken not to interfere with the blood supply to the ureter, and when this is impossible a neoinplantation of the ureter into the bladder may be indicated.



The author states that he has seen instances in which the ureteral orifice was involved in the diverticulum but he does not specifically state that he has ever operated upon such a case; however, this would probably also be an indication for neoinplantation. The muscular collar of the neck of the diverticular sac is cut through down to the mucosa and peeled back and the neck is doubly ligated and cut between the two ligatures. The stump is then buried, first with a circular suture (pursestring) in the muscular neck and then the whole is invaginated by interrupted sutures. Finally, a rubber drainage tube and a couple of strips of gauze are led up to the suprapubic incision, or if the sac has been too deeply embedded a drain is led out through the perineum, according to the method of Geza Illyes of Budapest or a modification thereof. The use of an indwelling catheter for a period of 4 or 5 days completes the technique.

The author does not favor marsupialization of the diverticular sac with cauterization of the lining mucosa because of the long drawn out process of healing and the chance of secondary hemorrhage from the marsupialized surfaces.

JOHN W. BRENNAN, M.D.

Marshall, V. F., Pollack, R. S., and Miller, C.: Observations on Urinary Dysfunction after Excision of the Rectum. *J. Urol.*, Balt., 1946, 55: 409.

Urinary dysfunction is much more common after excision of the rectum than after surgery performed above the pelvis (exclusive of neurosurgery).

The charts of 600 consecutive patients having operations upon the large bowel were reviewed. One hundred and eighteen, or 19.66 per cent, had severe urinary difficulty. Surgical procedures for the condition, however, were done on only 17, or 2.83 per cent.

Since the perineal surgery seems to be the main cause of the urinary complications, the author attempted to determine the conditions which might result from the perineal procedures that at least theoretically could produce such complications—complete urinary retention, paradoxical incontinence, residual urine, difficulty in voiding, and sometimes true incontinence. Urinary infection was the rule but it was almost always secondary.

First, trauma alone could cause urinary obstruction. Edema from trauma alone, however, would usually pass in a few days. Hematomas should be discovered, and furthermore should eventually be out of consideration because they either organize and shrink, or liquefy. Ligation of the urethra would hardly go unnoticed. Stricture of the urethra would certainly be found on examination and the indwelling postoperative catheter should prevent it to a large degree. Acute angulation of the urethra would also probably be prevented by the indwelling catheter. Cystourethrograms on 13 patients having urinary difficulty after perineal rectal excision did not show acute angulation or stricture. Formation of a

mechanical block by inverted tissue into the bladder neck or urethra seems theoretically possible, but the cystourethrograms, and the endoscopic examination of more than 20 patients after rectal excision, lend no support to this possibility as a common cause. Hence trauma per se and obvious direct mechanical obstruction seem to play insignificant roles in the vast majority of patients having more than quite temporary difficulty.

Second, interference with nerve control must be considered. Before transurethral resection was used on these patients, most of these complications were ascribed to a neurogenic bladder. Tradition, then, favors this idea. Simple transurethral prostatectomy has relieved too many who, after resection, have no indication of neurogenic dysfunction. Of course, transurethral resection can greatly improve the function of some neurogenic bladders, but it does so by mechanical, not neurological means, the neurological status remaining. Furthermore, good results are not as easily or frequently obtained with neurogenic bladders as in uncomplicated prostatism.

Bladder dysfunction is more common after perineal excision of the rectum than after other operations on the large bowel.

The authors have been unable thus far to demonstrate neurogenic dysfunction as the underlying cause.

Surgical removal of obstructing tissue at the bladder neck will rectify most of these complications, but not all.

Certain clinical observations led to a theory of the mechanism whereby these complications usually occur.

Application of this theory to the small group of patients continuing to have dysfunction after all obstructing tissue had been removed has given encouraging results. The theory is concerned mainly with elevation and fixation of the bladder and urethra. In practice this was performed suprapubically.

The group of cases here reported is small and too positive deductions must be avoided, but these observations may help to clear up some of the obscure factors concerning the mechanism of urinary control.

JOHN A. LOEF, M.D.

## GENITAL ORGANS

Alcala Santaella, R.: The Clinical Anatomy of Prostatic Tumors (Anatomía clínica de la tumoración prostática). *Arch. espan. urol.*, 1945, 2: 230.

In a previous publication, the author has reported his dissections on the musculature of the urinary bladder and his x-ray studies of the normal act of micturition, and in this article he turns his attention to the abnormal conditions produced by the enlargements of the prostate gland. Dissection was made of a number of postmortem specimens obtained from patients who had died before the second stage of the prostatectomy could be accomplished. This of the prostatectomy was combined with molds of the bladder cavity in

wax, showing the effect of the growth of the adenoma of the prostate on the size and shape of the bladder cavity.

Even during the operation on these patients it is noticeable that the morphological variations present important phenomena manifested by prostatic enlargement, chronic retention, or frequency of urination, frequency of urination, and acute retention. The on the basis of his studies, as a compensatory process on the part of the detrusor mechanism to overcome the condition of hypertonia of the sphincter muscle, which is in turn induced by congestive phenomena and irritation of the nervous mechanism supplying the neck of the bladder caused by the encroachment of the enlarging prostate on this region.

However, in the author's opinion, the symptoms of dysuria have a different explanation: They are essentially a phenomenon of muscular alteration. As the prostatic adenoma enlarges, its growth is directed upward toward the floor of the bladder by the resistance below of the external sphincter and membranous urethra which remain intact (incontinence rarely develops following suprapubic prostatectomy). However, the internal sphincter is dilated and displaced downward and the neck of the bladder of the bladder. Now, normally, the so-called neck of the bladder continues beyond the muscular triangle of the trigone but drops downward at an angle of 95 degrees; this the author designates as the posterior lip of the neck of the bladder, and he has demonstrated roentgenologically that it retracts under the pull of the muscles of the trigone and, to some extent, of the rest of the muscles of the bladder and the neck of the bladder and permits the detrusor mechanism to expel the urine in the act of micturition. In the presence of prostatic tumor the growth dilates the internal sphincter and pushes against the anterior edge of the trigone (posterior lip of the neck of the bladder); this modifies the angle of the structure and interferes with its mobility. Since the retractability of the posterior lip seems to be essential for the free act of micturition, rigidity or lack of free mobility is assumed to cause a hindrance. As a matter of fact, chronic retention is seen in conditions of stricture or connective tissue infiltration of the bladder neck; and tonometric studies on the bladder show that also in cases of prostatic patients a rise in pressure inside the bladder from a normal reading of 30 c.c. of water to 75 c.c. occurs before micturition is effected. That is, the mechanism of micturition is a complicated phenomenon, requiring an equilibrium between the musculature of the bladder neck, the internal sphincter, and the detrusor muscles, and it is the disturbance of this equilibrium by the obstacle in the form of the prostatic tumor which is responsible for the chronic retention in the afflicted patient. It is only one step further to the stretching and dislocation of this musculature to the point of

paralysis or impotence which leads to the condition of acute retention with all its consequences.

JOHN W. BRENNAN, M.D.

Lowry, E. C., Beard, D. E., Hewit, L. W., and Barner J. L.: Tumors of the Testicle. *J. Urol.*, Balt., 1946 55: 373.

Tumors of the testicle comprise approximately 4 per cent of all malignancies of the genitourinary system in civilian hospitals. Teratoma of the testicle represents approximately 70 per cent of all neoplasms of the genitourinary system, and 7.86 per cent of all malignant tumors.

For many years there has been quite a diversification of opinion regarding the classification of teratoma of the testicle. The classification employed by the majority of urologists is that suggested by Ewing, which is based upon the microscopic appearance or cell type of the tumor. Malignant tumors of the testicle are considered to arise from a cell which is capable of producing tissue resembling that arising from any or all germinal layers. It would appear that these tumors have a common origin since in this and other series of cases, all types of tissue, embryonal carcinoma, seminoma, adenocarcinoma, and adult elements, have been found in a single tumor, and various combinations of the above have frequently been observed.

The chief complaint in 86 per cent of the cases reported herein was "painless swelling of the testes," which in most cases was accompanied by other symptoms referable thereto, such as heaviness in the scrotum, and the mechanical interference of the enlarged testis during exercise. Six patients in this series complained of pain in the affected testicle, the pain varying from a dull ache to sharp incapacitating pain. These cases were all of the type with a history of sudden enlargement of the testicle within a few days prior to the onset of pain.

Four patients in this series were admitted with complaints referable to the spread of the disease: 2 with masses in the left supraclavicular fossa, and 2 with hydronephrosis. These patients were not aware upon admission that they had an enlarged testicle. Other symptoms such as weight loss, cough, loss of appetite, indigestion, and backache were frequent, particularly in cases with demonstrable metastasis. The diagnosis of teratoma of the testicle can, with few exceptions, be made with accuracy by physical examination.

The enlarged testicle invariably maintains the configuration of the normal testis, no matter what size it attains. The tumor is usually of uniform consistency and is firm and rubbery. The affected organ is usually stony hard in the adult type of tumor. The successful management of teratoma of the testis depends mainly upon an early diagnosis. The average interval in these cases between the first symptoms noticed by the patient and operation was 10 months. Allowing sufficient time for the Friedman modification of the Aschheim-Zondek test to be of diagnostic value is a cause of delay in many cases.

Malignancy of the testicle may be confused with epididymitis, orchitis, hydrocele, hematocele, torsion of the cord, tuberculosis, and syphilis of the testicle. The quantitative analysis of the urine for prolan A has proved to be a valuable adjunct in the diagnosis of these tumors in some clinics. Not only is the diagnosis made, but the type of tumor is said to be predicted with a fair degree of accuracy. In the authors' hands this test has not been found of such value, either as a diagnostic aid or in predicting the prognosis of the case, chiefly because of the technical difficulty in performing the test.

An excretory urogram is of value in locating abdominal metastasis not detectable by other means. The retroperitoneal lymph nodes to which these tumors spread lie along the course of the ureters and enlargement is detected by the observation of filling defects in the ureter, displacement of the ureter or kidney, or hydronephrosis in more advanced cases.

Metastases from teratoma of the testis are prone to occur early and with rare exceptions are spread by way of the lymphatics. The lymphatic drainage of the testis is almost entirely to the periaortic nodes. The main lymphatic channels accompany the spermatic vessels from the testicle through the cord as far as the level where the vessels cross the ureter, and from here they lead directly to the periaortic nodes from the level of the bifurcation of the aorta to the celiac axis at a region near the renal pedicles.

Metastases having once entered the regional drainage nodes, rapidly spread from the celiac axis to the subdiaphragmatic nodes, thence to the mediastinum, and by way of the thoracic duct appear at Virchow's node in the supraclavicular region. Once this node is involved one can be relatively sure that extension has occurred to the mediastinum and upper abdominal lymph nodes.

In this series of cases, metastases were found to exist in 32 cases, spread invariably by way of the lymphatics. In 1 case in which the patient died after the vena cava was invaded by direct extension of the metastases along its course, death resulted from a pulmonary embolus.

This group of 100 cases was treated in general by the same method, that is, after the method described by Dodson. In this method the testicle is removed after ligation of the spermatic cord at the level of the internal inguinal ring. An incision is made parallel to the inguinal canal on the affected side, from 6 to 10 cm. in length, according to the size of the affected testicle. The incision is not extended into the scrotum. The external oblique is divided in the line of its fibers for an equal distance. The spermatic cord thus exposed is ligated at the level of the internal inguinal ring before the testicle is disturbed. The testicle is then delivered into the wound and removed by gentle traction. In this series of cases a more radical orchectomy with dissection of the lymph glands on the affected side was not performed. Since many cases have metastases on the opposite side, lymphatic dissection on the affected side is not considered a curative procedure. A radical retroperitoneal ab-

dominal lymphatic dissection was performed elsewhere in 1 of the cases reported herein. Large abdominal metastases developed later on the opposite side and the patient is now bedridden from the disease.

X-ray therapy was generally started as soon as the patient could comfortably be transported to the x-ray department—in from 3 to 5 days after operation.

All treatments were given with the following factors: 220 k.v. (G. E. Maximar), 15 ma., 50 cm. target skin distance, from 0.5 to 1 mm. of copper and 1 mm of aluminum filter added (half value layer from 0.9 to 1.35 of copper), and from 42 r. to 31 r. per minute measured in air.

The plan of x-ray therapy depends upon the presence of metastases before treatment, the duration of symptoms for 6 months or longer, or the absence of metastases at any time and the duration of symptoms for 6 months or less.

The results obtained to date in the treatment in this series of cases have been somewhat discouraging. Twenty-four patients had definite demonstrable metastases upon admission and in 2 others metastases developed while they were in the hospital. Subsequent examination revealed that 12 additional patients now have demonstrable metastases. When x-ray therapy was administered to the cases with metastases, there was an appreciable diminution in size or disappearance of the metastatic mass in only a few. In the cases which responded initially there was subsequent recurrence. In several cases definite advancement of the disease was noted during the course of the treatment.

Fourteen patients in the group are now dead; an additional 8 are bedridden and are dying from the disease. Of the 100 patients, 68 are now living and well and are without evidence of metastasis at this time. The length of time that has elapsed since operation in these cases varies from a few weeks to three years.

JOHN A. LOEF, M.D.

## MISCELLANEOUS

Weens, H. S., Newman, J. H., and Florence, T. J.: Trauma of the Lower Urinary Tract. *N. England J. M.*, 1946, 234: 357.

The authors present a series of 7 cases featuring trauma of the lower urinary tract in which the diagnosis was made satisfactorily by the retrograde injection of a radiopaque contrast medium. Disadvantages of other diagnostic procedures are cited. The clinical history and physical examination may be inadequate for accurate determination of the site and extent of the injury. Urinalysis may be misleading. Urethral catheterization, in addition to introducing further trauma, may not rule out the possibility of vesical rupture since urine may be drained from the peritoneal cavity. Cystoscopy, in addition to being traumatic, may fail to establish a diagnosis. Pneumocystograms present a problem in maneuvering the injured patient between the recumbent and upright positions and, further, introduce the hazard of air embolism.

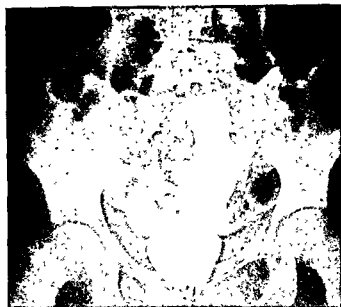
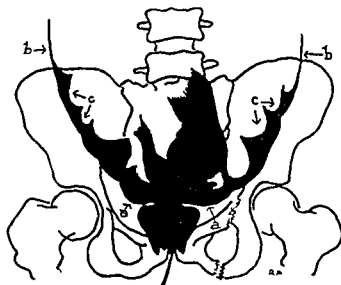


Fig. 1. Left, this is a retrograde cystogram showing extensive intraperitoneal extravasation. Right, note the accumulation of contrast medium in dependent portions



of the peritoneal cavity (a) and the paracolic recesses (b), as well as the scalloped filling defects of the contrast medium produced by the intestinal loops (c).

Retrograde urethrograms and cystograms present a diagnostic method by which any injury which interrupts the continuity of the urethra or bladder may be demonstrated with a minimum of manipulation, pain, and trauma. In cases of vesical rupture, the cystogram assumes a highly characteristic pattern. In intraperitoneal rupture, the opaque medium

has a tendency to accumulate and penetrate into the more dependent portions of the pelvic peritoneal cavity when the patient is in the supine position. The distended intestinal loops cast round or cylindrical filling defects in the extravasated contrast



Fig. 2. Another retrograde cystogram showing intraperitoneal extravasation; characteristic filling defects in extravasated medium produced by intestinal loops.



Fig. 3. This is a retrograde urethrocystogram. Note the extensive extravasation in the region of the posterior urethra.

medium, which are easily recognized. In addition, the accumulation of contrast medium as a bandlike or linear density along the peritoneal reflection of the flanks (the paracolic recesses) produces a highly significant roentgenologic sign. The haustral markings of the colon and loops of small intestine may produce a scalloped impression along the inner aspect of these bands of increased density.

Posterior urethral and extraperitoneal vesical ruptures are characterized by more or less diffuse penetration of the contrast medium into the tissues of the pelvic floor and prevesical space. In massive extravasations the medium may assume a sunburst-like appearance. Smaller extravasations are represented by streaky and feathery bands extending from the urinary bladder toward the surrounding soft tissue structures. The urinary bladder may assume an elongated pear shaped appearance or may be dislocated in any direction.

A combination of intraperitoneal and extraperitoneal rupture of the bladder, not encountered in this series, might be expected to assume the characteristic roentgenologic features of both conditions.

Intravenous pyelograms may fail to reveal vesical rupture, even though an apparently satisfactory cystogram is produced, either because of insufficient concentration of the contrast medium or insufficient pressure to produce leakage from the bladder. Cystography by means of a urethral catheter introduced into the bladder may not indicate the presence of urethral rupture, since the catheter is carried past the site of injury. In this case, retrograde urethrography is a necessary adjunct.

The authors conclude that retrograde urethrography is a simple, safe, and accurate method for the detection of trauma of the lower urinary tract.

CLARENCE V. HODGES, M.D.

**Exley, M.: Penicillin Treatment of Urinary Infections Caused by Pyogenic Cocci. *J. Urol.*, Balt., 1946, 55: 435.**

One hundred and one cases of urinary tract infection with pyogenic cocci were treated with penicillin.

Penicillin is less satisfactory in the treatment of urinary tract infections than in other types of infection because the majority of the former are caused by organisms which are relatively insensitive to penicillin, i.e., the bacillus coli and the bacillus proteus. However, penicillin is of definite value in the treatment of pyogenic cocci in the urinary tract. It is not subject to action interference by pus, tissue autolysates, or peptones as are the sulfonamides. Of the sensitive organisms found in the urinary tract, beta hemolytic streptococci and most staphylococci can be destroyed. The streptococcus viridans and fecalis were found to be only moderately sensitive. The successful treatment of staphylococcal infections requires twice the dosage necessary for streptococcal infections. Gram negative rods, including the bacillus coli, contain penicillinase which destroys the inhibitory effects of penicillin. Because of the non-susceptibility of these organisms in a mixed infection

the value of associated sulfonamide therapy is suggested. Although the bacillus proteus does not produce penicillinase, the action of penicillin on this bacillus and on bacillus pyocyaneus is nil.

With few exceptions, organisms unable to inactivate penicillin were susceptible to its action if free urinary drainage was present and anatomical abnormalities were previously eliminated. Infections complicated by the presence of stone, hyperplasia of the prostate, bladder diverticula, and urethral stricture require more than the administration of penicillin to effect a lasting cure. In 4 cases of calculous pyelonephritis failure occurred. After removal of the offending calculi followed by penicillin treatment the patients became asymptomatic and sterile urine cultures were obtained.

Because of the fact that penicillin is bacteriostatic and not bacteriocidal the treatment period should be no less than 3 days. The best results were obtained in the 6 day group and with a daily dosage of from 250,000 to 350,000 Oxford units. Cure was obtained in 78.2 per cent of the susceptible pyogenic cocci infections in this series.

An insufficient amount of penicillin may result in the development of resistant strains of the organism. Therefore, care should be taken to prescribe a sufficiently large dose initially.

FREDERICK R. LIEBERTHAL, M.D.

**Sarnoff, S. J., Freedman, M. A., and Hyman, A. A.: The Treatment of Bacillus Proteus Infections with Nu-455. *J. Urol.*, Balt., 1946, 55: 417.**

In a recent study on Nu-455, it was found that this sulfonamide derivative had several features to recommend its clinical trial. It is of low toxicity, has a rapid absorption rate, holds a blood level well, and gives high concentrations in the urine. It is many more times soluble than the next most soluble sulfonamide, and even in the absence of concomitant alkali medication, fails to give laboratory evidence of renal irritation or precipitation in the kidneys. The latter fact is of considerable importance in the treatment of bacillus proteus infections of the urinary tract, since this organism itself renders the bladder urine alkaline, which makes it difficult to determine whether alkali medication has succeeded in raising the pH of the urine. Since crystalluria was not encountered at the varying hydrogen ion concentrations of human urine without alkali medication, it was believed that pharmacologically this drug was particularly well suited to the treatment of bacillus proteus infections.

Nu-455 may be administered orally, intravenously as a 10 per cent solution of its lithium salt, or intramuscularly in the same concentration. It may also be used for local irrigation.

The treatment of a series of 15 cases of bacillus proteus infections with Nu-455 was undertaken. All but 1 were infections of the urinary tract. With 1 exception, 3 positive cultures were required before any patient was included in the study. At least 3 successive negative cultures were required before

bacteriologic reversal was assumed. All specimens were placed in media to which para-aminobenzoic acid had been added. The dosage schedule varied between 5 and 8 gm. per 24 hours.

Nine of 11 cases returned 3 successive negative cultures, the remaining 2 were modified by therapy, but did not meet the criterion for bacteriologic reversal (3 successive negative cultures). The 4 other cases were apparently entirely uninfluenced by drug therapy. In the patients with 3 successive negative cultures, the first negative culture was obtained from the third to the thirteenth day, the average being on the sixth day.

Of the 4 patients completely unaffected by Nu-455 medication, 1 had a squamous cell carcinoma of the bladder, and cystoscopy revealed, on several different occasions, that the tumor was necrotic and contained areas of devitalized tissue. The second patient received his course of therapy between the first and second stages of a suprapubic prostatectomy, at a time when a large, obstructing prostate and a suprapubic tube were still in place. The third case was treated inadequately, with only 22 gm., during the first course of therapy. The drug was stopped at this time because of a febrile response, which was at first attributed to the drug. The patient's subsequent course indicated that this assumption was not true. A transurethral resection was followed by the development of a retroperitoneal abscess from which the bacillus proteus was cultured. Further therapy in the presence of this condition failed to eliminate the organism. The resistance of this organism may possibly be attributable to previous exposure of this

strain to inadequate amounts of the drug. The fourth case also received the course of therapy between the first and second stages of a prostatectomy, with prostatic obstruction and a suprapubic tube present. Sulfadiazine did not affect this patient's organism.

Of the 6 patients from whom 3 successive negative cultures were not obtained, 4 had suprapubic tubes *in situ*, and 1 had a continuous indwelling catheter. The sixth case was a clinical cure in the sense that the urine became crystal clear and the patient was symptom free after therapy. The 6 bacteriologic failures might have been anticipated, since a suprapubic wound infected with the bacillus proteus is relatively resistant to the usual blood concentrations of the drug and will serve as a nidus and continually seed the urine with organisms. The inhibitory effect of pus on the action of sulfonamides and the difficulty of eradicating infection in the presence of tumor, stasis, or stone are well known. Nevertheless, it will be noted that in 3 of the 9 patients in whom a bacteriologic reversal was produced, there were open wounds at that time.

In several patients the bacillus pyocyaneus was also present in the urine, but in only 2 patients did the time relationship suggest the possibility that the bacillus pyocyaneus might be responsible for the elimination of the bacillus proteus.

Other organisms, such as the enterococcus, bacillus coli, and bacillus pyocyaneus, found concomitantly with the bacillus proteus, did not seem to be affected favorably by therapy with Nu-455.

JOHN A. LOEF, M.D.

# SURGERY OF THE BONES, JOINTS, MUSCLES, TENDONS

## CONDITIONS OF THE BONES, JOINTS, MUSCLES, TENDONS, ETC.

Grace, E. J., and Bryson, V.: Penicillin for Osteomyelitis. *J. Am. M. Ass.*, 1946, 130: 841.

With regard to the treatment of patients with chronic osteomyelitis, the authors state that the medical profession is divided into a majority group who favor radical surgery with extensive saucerization followed by skin grafting if necessary, and a minority group who place primary reliance upon chemotherapy in the treatment of chronic osteomyelitis, with surgery reduced to a minimum compatible with successful treatment.

The authors' studies of penicillin-detergent combinations are designated to eliminate by means of the detergent the isolation of penicillin-susceptible bacteria in sequestra, sclerosed bone, abscesses, poorly vascularized sinus tracts, and soft tissue scars. The bacteria are then eliminated by the penicillin which has increased antibacterial properties as a result of the detergent.

The therapeutic program consists of a complete physical examination with the correction of obvious deficiencies such as anemia and focal infection. The authors stress the importance of the primary elimination of evident foci of infection. After the preliminary steps, the patient is hospitalized and every 3 hours receives injections into each sinus tract of 3 c.c. of penicillin consisting of 200,000 units dissolved in 25 c.c. of the wetting agent, aerosol O.T. or sodium tetracycl sulfate 0.1 per cent. This is supplemented by intramuscular injections of 20,000 units of penicillin every 3 hours for four doses and then 10,000 units every 3 hours night and day. For the topical application, 20,000 units per cubic centimeter are sometimes used. Only 25 or 50 c.c. are prepared at one time in order to insure a fresh solution. At times, dressings wet with tyrothricin and covered with a compression bandage are used.

Seven cases are reported with 1 definite failure.

DANIEL H. LEVINTEAL, M.D.

Purriel, P., Cagnoli, H., and Espasandin, J.: Brucellosis Spondylitis (La espondilitis brucelosa). *Rev. ortop. traumat.*, B. Air., 1945, 15: 3.

Practically 100 per cent of the cases of brucellosis in Uruguay so far have been of the abortus variety. In the acute phase of the disease, the general signs and symptoms dominate the picture, and in only 1 of 150 acute cases, destructive changes of the spine were found by the authors. On the other hand, localized changes are very frequent in the chronic phase, i.e., in ambulatory patients. This difference in frequency of general and localized changes is typical for brucella abortus infection, and does not hold true for infections produced by the brucella suis or melitensis.

The lesions of the spinal column are either destruction of the bone (spondylitis) or they involve the bones and joints (spondylarthrosis). They may occur in any age group, and in either sex, yet men outnumber women at the rate of 8 to 1, and in the authors' series all of the patients were males. Most frequently the lumbar spine is involved, yet thoracic involvement is not rare, and cervical spondylitis due to brucellosis occurs occasionally.

The authors are amazed that up to 1939 only 66 cases of disease of the spinal column due to brucellosis had been described in the United States, as they found 62 per cent of their cases of spinal column disease due to this condition. They explain this discrepancy as follows: (1) there have not been any systematic roentgenological studies of the spinal column in brucellosis; (2) the lesions very often produce only very slight symptoms or none at all, (3) in the acute stage, when the patient complains of backache, roentgen-ray studies are usually negative.

The authors roentgenographed their brucellosis cases systematically every 3 months, studying the spine. This procedure not only revealed numerous lesions, but permitted the study of their evolution.

There are three clinical types of brucellosis of the spine:

1. The acute condition in which the patient suffers from backache. While this is the period of septicemia and of the onset of inflammatory processes in the bone marrow, x-ray studies of the spine are negative at this time.

2. The chronic condition in which the pain is localized, intense, unrelieved by rest, and intensified by movements; it may be bilateral and/or descend (sciaticlike). There are contractures and other muscular impairments. There are roentgenographic changes. The agglutination reactions in this stage have diminished or disappeared, and the blood culture is negative. The only diagnostic findings are a positive skin test and opsonic index. In addition, the patient's history and epidemiologic facts contribute to the diagnosis.

3. Old vertebral lesions. The diagnosis in these cases is especially difficult, as there is a discrepancy between the number of patients infected (contacts) and those actually afflicted. Positive skin reactions and opsonic indices are not enough to ascribe a given lesion with certainty to a brucellosis infection, a fact which is of considerable scientific as well as legal importance.

WILLIAM E. RICKETS, M.D.

Stout, A. P.: Rhabdomyosarcoma of the Skeletal Muscles. *Ann. Surg.*, 1946, 123: 447.

In a careful survey of the literature on rhabdomyosarcoma of the skeletal muscles, the author has been unable to find satisfactory information concern-

ing the biologic habit of the tumor and especially about the efficacy of treatment. To the already published cases he has added 14 of his own, making a total of 121 cases that are analyzed in this article.

The rhabdomyoblastic tumor cell is extremely variable in size but, in general, it is rather large and assumes one of three different shapes. It is rounded, strap shaped with two or more nuclei arranged in tandem, or racquet shaped with a single nucleus at one expanded, rounded end and a tapering body extending outward from this for a variable distance. With suitable stains either cross striations or longitudinal myofibrils, or some vague suggestion of their formation should be distinguishable in the majority of cases. It is usually not easy to find this differentiation even with good preparations and one must be willing to make a painstaking search with high magnification. The cytoplasm of all these cells is more or less strongly acidophilic. In 9 of the 14 new cases recorded one or the other of these differentiating features was found.

These tumors develop in animals as well as in man and they have been found in certain definite systems and regions of the body. These are more particularly the genitourinary system, the heart, upper respiratory and alimentary tracts, and the orbit; sporadic examples have been found in the lung, breast, esophagus, suprarenal glands, and brain. The writer was able to locate reports of 107 cases which had developed in the striated muscles and other soft parts of the body.

Because of other varieties of muscle cell tumors a simplified nomenclature for this group is suggested with the following terms: smooth muscle cell tumors—leiomyoma, leiomyosarcoma; striated muscle cell tumors—granular cell myoblastoma (benign and malignant types); rhabdomyoma of the heart muscle; rhabdomyosarcoma; and undifferentiated myosarcoma.

There were 62 males and 52 females among the 114 patients of whom the sex was recorded. The age variation was extreme and cases were reported in all decades including the ninth with the preponderance in the fifth and sixth decades. In almost every case the tumor developed either within or attached to a peripheral striated muscle. The distribution of the 123 tumors (2 patients each had 2 independent tumors) was as follows: lower extremity—52 cases; upper extremity—17 cases; trunk—31 cases; head and neck—19 cases; diaphragm—3 cases; and psoas muscle—7 cases. The duration of the disease is variable and in 1 case the clinical course from the onset of symptoms until death was only 2 months, while in another the tumor persisted after 50 years. One must be very cautious in predicting the probable duration of these tumors. Commonly the only symptom is tumor, which in 88.5 per cent developed without any history of antecedent trauma and, often, without pain or interference with function. Sometimes the growth compromises the overlying skin and the tumor fungates, which may also happen after biopsy. The size and consistency are variable. These tumors

infiltrate insidiously, and metastases through the blood and lymphatic channels are not uncommon, with the lungs as the most favored repository.

Only 4 symptom free 5 year survivals are reported among the 121 cases, 108 of which received treatment. One of these was treated by amputation alone, 1 by excision alone, and the other 2 by excision and radiotherapy.

From the published data it is impossible to select the best form of treatment arbitrarily. It is manifest, however, that in a very large number of cases the first procedure was an inadequate excision, and that one should be able to cure this neoplasm more often if it is attacked earlier and in a more radical manner. An extended study of cases of malignant tumors of the peripheral soft parts and bones has convinced the author that they should not be attacked by blind removal before definite knowledge of their nature is obtained by biopsy. If the tumor is treated without knowledge of its nature one runs the hazard of removing too much or too little, usually the latter. A small biopsy with the minimum amount of trauma will furnish the information necessary for proper action and of itself will do no harm. In the case of the rhabdomyosarcoma, treatment should certainly be radical with the removal of a large block of surrounding uninvolved tissues. This may or may not mean amputation.

The author's 14 cases are described in abstract form and some are illustrated with photographs of the patients, specimens, and microscopic material. The detailed clinical data of the 121 cases are presented in tabular form and an excellent bibliography is added.

CHARLES A. WALTSMAN, M.D.

## FRACTURES AND DISLOCATIONS

Soeur, R.: Intramedullary Pinning of Diaphyseal Fractures. *J. Bone Surg.*, 1946, 28: 309.

In 1940 Kuentscher first demonstrated convincingly that osteosynthesis could be secured along the medullary cavity of the long bone. He described longitudinal fixation by means of metallic material occupying the full length of the medullary space. The material was a rod of as large size as the bone canal permitted. The material was introduced by an extra-articular route as far from the fracture site as possible, and without exposure of the fracture. The material was completely buried. The end of the prosthesis, which extended beyond the bone, was covered by the soft parts and the skin. The reduction had been retained by external maneuvers before the intramedullary fixation. After consolidation of the bone, the prosthesis was extracted. The author's experience with this method was secured with a total of 55 operations.

The chief objection to medullary pinning is the destruction of the bone marrow. Even if the prosthesis should destroy all of the medullary content, Soeur believes that the individual is able to do without the hematopoietic element in one of the long bones. In so far as the blood of the patient subjected



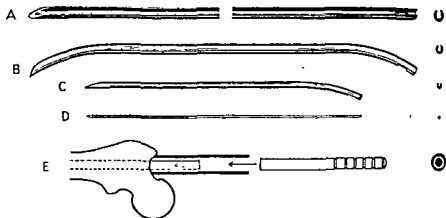


Fig. 1. Prostheses and pin driver. A. Straight pin of grooved bar of steel (V-2A). One end is pointed, the other shows a small eye. In profile these pins are in the form of a U. For a femoral diaphysis, the diameter of the pin is usually 8 mm. The thickness of the sides of the U is 2 mm. For the humerus and the ulna the pins are similar, but shorter and thinner. B. Tibial pin, made of the same material as the straight pin, and from 6 to 8 mm. in diameter.

It is curved at both ends. The point of the curve is generally 1.5 cm. from the end. C. Radial pin, 5 mm. in diameter. It has a single curve. D. Threaded rod for the ulna and radius, from 2 to 3 mm. in diameter. E. Graduated pin driver. The guiding tube has been slid over the pin up to the bone. The mandril will be introduced into the tube. The graduations on the mandril show the extent to which the pin penetrates the bone.

to medullary pinning is concerned, the changes are very mild and of little concern to the surgeon. The risk of fat embolism is of more importance. Statistics based on more than 100 fixations, which have been published, affirm that the method does not predispose to the danger of embolism. Only once has the author seen a postoperative pulmonary embolism. At present the risk appears to be slight. In his opinion, the septic complications—all other factors being equal—are less to be feared after medullary pinning than following other methods of osteosynthesis. There is little trauma and the method entails less disturbance of the muscles and manipulation of the fragments than occurs with open procedures. The method is contraindicated in compound frac-

tures. According to the author the presence of a foreign body in the medullary cavity does not in itself predispose to infection. Osteomyelitis in the entire diaphysis need not be feared, even when the operative site becomes infected.

The operation causes little shock. Medullary osteosynthesis is a safe procedure. The incision is short; there is little hemorrhage; bleeding is reduced to a minimum since the site of the fracture is not often opened. The postoperative well-being and objective state of the patient is truly astounding and they remain so in the days that follow.

2. The prosthesis is simple. The bloodless reduction of the fracture is tedious because of roentgenographic control and successive corrections. The op-

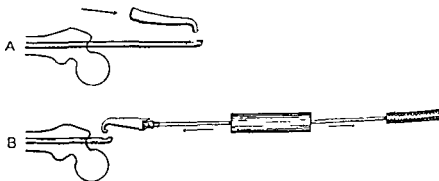


Fig. 2. Extractor. A. The instrument is 18 cm. long. A hook fits into the eyelet of the pin. By blows with the tip of the hammer, one frees the prosthesis. This instrument is useful in the operation when it is necessary to retract the pin in order to change its direction. B. Hammer-extractor permits the freeing of a pin when the head of the pin alone

is accessible (after consolidation). The rod, 35 cm. long, has a hook attached to one end and a handle to the other. A metallic mass, weighing 1 kgm., moves freely on the rod. While the assistant holds the handle, the surgeon drives the mass violently against the handle.

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eration is performed under spinal or local anesthesia. When end-to-end opposition has been obtained the place the operation is easy. With the pin in necessary to perform an open reduction operation, reduction of the fracture is all that is required. It is essential to maintain apposition of the fragments during the time the bed is being prepared for the fitting and while fixation is done.

3. The formation of callous is rapid. The callous forms more quickly if medullary metallic fixation is employed than with any other method. It may be that the presence of a foreign body in the medullary canal is responsible for this. The hypertrophy of the callus is more pronounced whenever a thick prosthesis is used and less intense whenever the material is very thin.

4. Early mobilization is possible, because there is no pain, because callous forms rapidly, and because the part of the limb is firmly fixed. Active mobilization begins from the first days following the operation. Patients with operations upon the thigh usually walk about with two canes by the sixth week. Those with operations upon the leg get about by the twelfth day. Patients with operations upon the upper arm are able to contract the deltoid muscle; with operations upon the forearms they can move the fingers. Massage and other forms of physical therapy are generally superfluous, since the joints maintain suppleness and the muscle tone, while the circulation remains normal. Hospitalization is greatly reduced in comparison with that required by other methods of treatment, notably continued extension.

The author described the technique which is recommended for the femur, tibia, humerus, forearm, and other fractures. He gives in detail a description of the type of pin, the position of the description reduction, the introduction of the pin, the osteosynthesis, the postoperative care, the removal of the prosthesis, and the results.

The results obtained in 23 diaphyseal fractures of the femur, 10 of the leg, 9 of the humerus, and 13 of the forearm are analyzed critically. The author outlines the operative indications but does not advise intramedullary pinning in compound fractures. However, he recommends it very highly in closed fractures, especially those of the femur and of the forearm.

**Narisimhan, N. S.: Recurrent Dislocations of the Shoulder Joint. *Ind. J. Surg.*, 1945, 7: 123.**

The author reviews the anatomy, pathological changes, and the various theories of the mechanism of recurrent dislocation of the shoulder. In 99 cases of recurrent dislocation of the shoulder, 16 of which were operated upon, the author found that the capsule was never lax, the labrum glenoidale was detached from the margin of the glenoid in 11 cases. There was no abnormality of the humeral head or glenohumeral ligaments.

The Bankhart operation was done on 12 patients, the Claimont operation on 2, and the Nicola operation on 2. The results of the various procedures compared in the literature are tabulated, and their comparative merits noted.

**DANIEL H. LEWINTHAT, M.D.**  
**Med. J. Australia, 1946, 1: 352.**

The author presents a review of 124 cases which he treated in military hospitals in a period of 3 years preceding March, 1945.

Because of the elongated shape of the scaphoid bone and the fact that it lies in the proximal as well as the distal row of the carpal bones, this bone is very susceptible to injury. In a fall, the outstretched hand is held firm by the long forearm muscles and the force traveling through the capitate cracks and the scaphoid across the edge of the radius "like a stick across one's knee." In older people and in women, Colles' fractures occur instead, because the wrist hyperextends and the lower end of the radius takes the impact of the blow. Some fractures of the scaphoid bone are discovered accidentally. Some patients seek medical aid because of persistent pain and stiffness after the injury and because of arthritis following nonunion.

Examination of 397 scaphoid bones showed that vascular foramina occur only in the narrow palmar and dorsal surfaces of the bone. In 13 per cent, it was found that foramina did not occur proximal to the waist of the scaphoid bone, which means that fractures occurring proximal to the vascular foramina deprive the proximal fragment of its blood supply. This fragment then supposedly undergoes necrosis. Not only does union occur very slowly, but arthritis develops because of the irregular shaped proximal fragment of the scaphoid bone once union has occurred. Because of these observations, early excision of the proximal portion of the scaphoid has been recommended.

The opposing view recommends excision to be done only if there is definite x-ray evidence of nonunion and necrosis, as shown by irregular notched densities and partial collapse of the bone fragment. This view was based on the following observations:

The hyperemic stage following fractures, during which the bones decalcify, usually is confined to the first 2 or 3 weeks. It is said that cancellous bone and cartilage survive 3 weeks until a new blood supply is established. If a fractured scaphoid is immobilized immediately after the injury, it is considered that a new blood supply can develop in the proximal fragment in less than 3 weeks, so that by the time the decalcification is again established in the proximal fragment, decalcification has ceased and the proximal fragment will remain denser than the rest of the bones without necrosis.

The treatment of the fractured scaphoid depends upon whether the patient is seen within 2 months of injury or after a longer period following injury. The early treatment consists of immediate, efficient, and

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persistent fixation of the wrist joint until the x-ray signs of fracture have disappeared. The immediate fixation is very important because the initial bone formation is the most potent force to bridge the gap and the life of the avascular proximal fragment depends upon this early bridging.

Five fractures of the tubercle united in the average time of 15 weeks. Fifty-three cases of fracture through the waist of the scaphoid were kept immobilized for from 15 to 30 weeks; all except 3 united. Seven cases of fracture through the proximal pole required immobilization for from 22 to 47 weeks; all united.

The patients who presented themselves for treatment more than 2 months after injury had a variety of roentgenological changes: delayed union, as shown by decalcification of the fracture line and "cyst" formation; nonunion, as evidenced by sclerosis along the fracture line; and arthritic changes, as manifested by a sharpening of the radial styloid or a narrowing of the radioscaphoid bone. Ten patients with delayed union had treatment for from 2 to 9 months after injury and were immobilized for an average period of 5½ months; union of the fracture occurred in all of them. Seven patients of the fracture occurred proximal fragment in 3, nonunion occurred in all. Thirty-two patients showed delayed union after having been treated for more than 9 months. Two of them were given a leather splint and 9 were treated; all of them showed nonunion at the termination of the treatment. Three were treated by means of a plaster cast only, and 6 were operated upon, 3 by grafting, and 3 by excision of the proximal pole.

From this review, it is evident that the best treatment for these patients is the application of a leather support since operation proved to be unsuccessful in all of the cases in this series.

In conclusion, it is stated that delayed union of the scaphoid with arthritis should be treated by fixation in a plaster cast. Arthritis with nonunion should be treated by change to lighter work and the application of a leather wrist support.

GEORGE I. REISS, M.D.

Speed, K.: Treatment of Fractures of the Hip; Surgical Technique. *Surg. Clin. N. America*, 1945, 26: 230

This article describes the surgical technique of the treatment of fracture of the hip employing either the three flanged Smith-Petersen nail or Moore pins. The standard operation for this condition is described and is a suitable reference for surgeons interested in the procedure.

For guides in driving the pins, two small strips of tin punched with digits in sequence and with small perforations at the extremities are used as markers. One of these strips is sewn over the middle of the inguinal canal over the region of the head of the femur or acetabulum by skin stitches passing through the perforations. The other strip is sewn to the skin at

a point 2 inches below the greater trochanter. The anteroposterior film definitely shows from which digit of the marker on the outer margin of the hip the operator must initiate his penetration of the neck and head of the femur, and aim at the specified distance of the second marker lying just in line with the head as seen in the roentgenogram. No matter what method of determining the direction of driving the fixation is used, the operator should never neglect roentgenological control before final insertion.

Errors of omission worth consideration are: Incomplete preparation of a sterile operating field, with resulting wound infection. Failure of roentgenological control during the process and at the end of fixation. The lateral view is particularly necessary to be sure that the head of the femur rides in proper position on the neck. If the head of the femur is not properly placed, the following may result:

- Insufficient penetration into the head of the femur by the fixation agent because it is too short or incompletely inserted.
- Too deep a penetration extending into the acetabulum. This may lead to separation at the fracture plane.
- Rotation of the head fragment during insertion of fixation after insecure reduction or with an improper angle of insertion. This will lead to loss of contact of the fracture surfaces.

Improper postoperative fixation. Care must be taken to avoid stress on the fixation, as this may lead to disjunction.

Errors of commission consist of:

- Incomplete reduction of the fracture. One should keep in mind the advantage of a slight external rotation.
- Improper angle of insertion of the fixation agent.
- Lack of ignorance or disregard of anatomy.
- Lack of immediate checking by roentgenological control. The operator may be too hurried or overconfident. The check-up should not be put off for several days.
- Lack of aseptic technique and unskilled operator by too much dependence on mechanical pointers or indicators.

Insufficient support of the leg after operation by whatever means the patient requires.

- Too early unguarded motion, especially abduction of the leg. The nurse must be familiar with the angle of the neck and the necessity for careful handling of a fine adjustment.
- Too early weight bearing, putting too much natural bone healing necessary for the complicated job of weight bearing and motions of the hip joint, as in walking and the like.

For the treatment of delayed union or nonunion of fracture at the neck of the femur, several types of subtrochanteric osteotomy are discussed with a satisfactory solution of this problem.

CHARLES A. WALDRON, M.D.

McCarthy, P. V., and Van Demark, R. E.: *March Fracture of the Inferior Pubic Ramus. M.H. Surg.*, 1946, 98: 233.

March fracture of the inferior pubic ramus is characterized by pain in the inguinal and perineal regions; the pain may also radiate to the knee. The pain in the knee is referred by way of the obturator nerves.

March fracture of the inferior pubic ramus usually occurs in persons who are not used to strenuous exercise and are suddenly subjected to it. Early diagnosis is based on clinical examination because the roentgenograms are of little value in demonstrating the fracture line, but as soon as callus has formed the roentgenograms will show a spindle type of callus formation around the fracture line.

The treatment is entirely symptomatic. Bed rest is not advisable. The 2 cases presented by the authors and the cases presented by Jones and Nickerson showed no untoward effects when treated ambulatorily. Most of the patients returned to duty after 4 months and had no complaints except occasional mild pain in the inguinal regions.

GEORGE I. REISS, M.D.

Foley, W. B.: *Treatment of Slipped Upper Femoral Epiphysis. Proc. Roy. Soc. M., Lond.*, 1946, 39: 201.

This article is the President's address to the Section of Orthopaedics of the Royal Society of Medicine. Concerning the etiology of slipped epiphysis of the upper part of the femur, confirmation of the observations of Howorth was made, i.e., the swelling of the synovial membrane seen at operation, the histological finding of a simple synovitis, the elevation of the blood sedimentation rate in early cases, and the constant appearance of juxtaepiphyseal decalcification in roentgenographs. However, the author is not inclined to accept entirely Howorth's proposal of an inflammatory etiology and suggests that except for the elevated sedimentation rate the findings might be due to traumatic synovitis and secondarily to the epiphyseal slipping rather than that they are the primary cause of it.

Since treatment is so much more satisfactory in early cases than in late ones, the cases are divided into two groups: (1) early cases with minimal epiphyseal displacement, and (2) cases with severe or complete displacement of the epiphysis. Group 2 may be divided into (a) acute cases with a short history usually including slight injury and symptoms and signs severe enough to suggest a fracture of the neck of the femur, and (b) cases with a long quiet history of increasing pain and deformity.

It is important to suspect this condition in any adolescent of either sex, between the ages of 9 and 18, who is complaining of limping or of pain in the hip and knee. Once the diagnosis is made or suspected all weight bearing should be forbidden absolutely, since if continued there is a grave risk that at any moment the case may pass from the favorable first group into the less favorable second group.

Excellent results are obtained by treating early cases by the insertion of a Smith-Petersen three-flanged pin across the epiphyseal line into the epiphysis without any preliminary manipulation or attempt at correction of the deformity, according to Wilson's technique. This technique was employed in 5 cases by the author with excellent results after a follow-up period that ranged from 1 year to 7 years. There was  $\frac{1}{4}$  inch shortening in 1 case only and slight limitation of internal rotation in 3 of the cases.

In evaluating his results the author employs the term "excellent" in patients who are quite symptom free and have either no limitation of hip movement or a few degrees of limitation of internal rotation only. Roentgenography shows no deformity or evidence of arthritis. Patients having "good" results are leading lives of normal activity with no pain, or only an occasional ache with weather changes, but have definite limitation of internal rotation and possibly also of flexion and abduction. Roentgenography may show some deformity of the head and neck, but no arthritic changes. Patients classified as having "poor" results have pain and/or gross limitation of all hip movement and possibly some fixed deformity. Roentgenography in these cases shows evidence of avascular necrosis or of arthritis.

Eight cases of Group 2 (a) classification were treated by manipulative reduction accomplished by means of the Leadbetter maneuver. Three of the patients were subsequently immobilized in plaster and in the other 5 the reduced epiphysis was pinned. In the former group the follow up period ranged from 8 to 14 years with an average of 10 years, with 1 excellent and 2 "poor" results. One of the patients subsequently needed arthroplasty of the hip. The follow up period of the pinned cases extends from 1 to 7 years, averaging 5 years, with 2 excellent, 2 good, and 3 poor results. In summary, among the 8 cases there were 3 excellent, 2 good, and 3 poor results. One of the pinned cases with a poor result is described; in this case avascular necrosis of the head occurred. Since this complication may occur in from 25 to 30 per cent of the cases treated in this manner, it is the author's opinion that the method should be abandoned.

An alternative way of treating this group is by strong skeletal traction employing a Steinmann pin through the lower third of the femur. The patient may be placed on a frame or the affected limb suspended in a Thomas splint and weights up to 20 pounds used. This strength of traction should not be maintained longer than 14 days at the outside, as there is some risk of interference with the blood supply from continuous tension on the capsule. If strong traction fails to reduce the displacement within 14 days this can be effected by open reduction through the epiphyseal junction. In 9 cases treated by this operation the follow up period ranged from 2 to 7 years and the results were: excellent in 1 case, good in 5 cases, and poor in 3 cases. The 3 poor

results were due to avascular necrosis of the epiphysis which resulted in restriction of movement as seen in fibrous ankylosis, and in 1 case it was accompanied by pain of sufficient severity to make arthrodesis necessary.

If reduction by strong traction fails and if both closed and open manipulation are to be condemned because of the high percentage of poor results, it is suggested that light traction may be continued till the epiphysis is fused in the position of deformity. This may be corrected by wedge osteotomy of the neck of the femur or by subtrochanteric osteotomy. In 9 cases treated by osteotomy of the neck, 5 patients were immobilized in plaster following the operation, and 4 were pinned. The average follow up period of the 5 plaster cases was 8 years and the results were all classified as good. The follow up period of the pinned cases ranged from 1 to 3 years. One result was classified as excellent and the 3 other results were considered as good. The majority of these cases had some shortening, but in no case did it exceed an inch. Most of them had some limitation of internal rotation and in some cases of flexion and abduction as well. Restoration of mobility of the affected hip was much speedier and rather more

complete in the pinned cases than in those immobilized in plaster after operation.

Investigation of the results of subtrochanteric osteotomy was disappointing since a number of patients so treated were of military age and could not be located. However, it is the author's impression that subtrochanteric osteotomy gives a satisfactory result in most cases and delays, if it does not prevent, the onset of mechanical osteoarthritis by improving the weight bearing alignment.

Four cases treated by a short period of traction in bed, followed by the wearing of a caliper splint for a year or longer, or treated by means of a calipersplint only were traced from 16 to 23 years later. From the results it is concluded that hips treated conservatively without operation can function satisfactorily for as long as approximately 2 decades. The uncorrected deformity may exist for many years without roentgenographic evidence of arthritic changes. There must not be too vigorous an attempt to obtain anatomical perfection if it involves the risk of serious impairment of function.

Case reports and illustrative roentgenographs are included in the article and a short bibliography is appended.

CHARLES A. WALKMAN, M.D.

# SURGERY OF THE BLOOD AND LYMPH SYSTEMS

## BLOOD VESSELS

Leriche, R.: *Arterial Thrombosis. Experimental and Clinical Conditions* (La thrombose artérielle, conditions expérimentales et cliniques). *Lyon chir.*, 1945, 40: 167.

The author reviews the mechanism of the coagulation of blood. All the factors necessary for coagulation are present in the circulating blood but normally intravascular coagulation is prevented by the constant secretion of heparin by the reticuloendothelial system.

Thrombosis is defined as intravascular coagulation, but whereas ordinary coagulation starts with a precipitation of fibrin, thrombosis begins with a conglomeration of platelets. Experimentally, thrombosis may be caused by slowing the blood stream at the site of a minor injury to the endothelium. Clinically, in human beings, however, this rarely causes the formation of a thrombus. The author mentions a case in which he had given 35 intra-arterial injections of mercurochrome with a tourniquet in place but there was no thrombosis. On the other hand, there are some individuals who develop extensive thrombosis with the slightest injury to a vein or artery. Apparently there is some unknown factor which predisposes to thrombus in certain people.

Thrombosis requires an endothelial lesion, but in most cases the obvious types of lesion are not apparent, e.g., gross trauma, and medial calcification. The author considers other factors. Infection including syphilis is rarely concerned. Some of the experimental work on the vasospastic effect of tobacco is reviewed, but the author finds it unconvincing. Exposure to cold, on the other hand, seems important. Patients who have had frost bite are prone to develop arteritis at an early age. Venous thrombosis is often followed by thrombosis of the adjacent artery. The loss of a large amount of blood frequently causes arterial thrombosis. It is suggested that the blood loss affects the viability of the intima, which in turn results in obliterative endarteritis. Yet, a sudden drop in blood pressure may precede thrombosis in apparently healthy arteries.

In addition to local factors, the author believes there may be an endocrine basis for arterial thrombosis. Experimental work would seem to incriminate the adrenals, gonads, and parathyroids, but the mechanism is still obscure. Arterial thrombosis is almost exclusively a disease of males. It is rare in negroes, and most frequent in Jews.

THEODORE B. MASSELL, M.D.

Leriche, R.: *The Laws of Arterial Thrombosis* (Les lois de la thrombose artérielle). *Lyon chir.*, 1945, 40: 477.

The time required for the organization of a thrombus varies according to the age of the individual, the

reparative power, and the state of the vessel lining. Calcium deposits, cholesterol, or fat crystals slow up the rate of organization. In some people there may be no signs of organization for many weeks. Experimentally, it has been demonstrated that with only a small area of intimal damage without infection the vessels that invade the thrombus will run parallel to the lumen of the thrombosed artery. If the parietal lesion is extensive and infected the vessels penetrate everywhere in a radial direction.

The author quotes Fontaine and Bauzen of Strassbourg who have formulated certain laws regarding the organization of arterial thrombosis:

1. The speed and the importance of the organization of the clot are in inverse proportion to the extent and the age of the endarterial lesions.

2. A decreasing significance of organization corresponds to an increasing significance of the endarterial lesions.

3. The organization of the clot occurs in a regular and essentially concentric form in young patients with arteritis, and in an irregular and diverging form in old arteritis.

4. The speed of organization of the clot is not so much a function of endarteritis or of the endothelial state as of the integrity of the media.

5. In aseptic thrombosis the new vessels are axial. In infected thrombosis they are radial.

The question is raised as to whether spasm alone can bring about thrombosis. While the author's clinical experiences have led him to believe it likely, he believes that this hypothesis cannot be definitely accepted without further investigation.

Whether a thrombosed artery is recanalized or not is of no functional significance. The author believes that a recanalized segment should be resected just as if it were completely obliterated.

The inflammatory reaction about a thrombus extends beyond the adventitia of the artery to the walls of the veins and the nerves which accompany it. However, an arterial thrombus rarely leads to a thrombosis of the vein, although the opposite process is frequent. Thus, the vein becomes adherent but not obstructed at the site of an arterial clot.

Upward extension from the site of arterial thrombosis tends to go to the first major collateral but may remain localized in a short segment. Distal extension occurs but slowly. Lumbar sympathectomy does not stop the extension of the clot but sometimes even seems to accelerate it. The only way to keep a thrombus localized is to excise it. Thrombosis does not seem to recur above a ligature.

Arteriotomy does more than stop the spread of a thrombus; it removes the vasoconstrictor impulses which arise from the thrombosed segment. By reducing the collateral circulation the vasoconstrictor effect of the thrombus is more important than the local arterial obstruction in causing ischemic gan-

grene. The author considers resection of the thrombosed segment just as effective as sympathectomy in achieving vasodilation of the collateral vessels.

If venous thrombosis occurs simultaneously along with arterial thrombosis the gangrene is fatal. It is massive and often of the wet variety.

Arterial thrombosis may be entirely silent and asymptomatic or it may cause extensive gangrene; this depends on the extent of the thrombus, the location in relation to the major collaterals, the presence or absence of hematoma and edema in the surrounding tissues, the degree of vasoconstriction of the collaterals, the presence of simultaneous venous thrombosis, and the adequacy of the general circulation. Treatment should be based on the knowledge and control of these various factors.

TRENDRE B. MASSELL, M.D.

**Allen, E. V.: The Challenge of Thrombosis and Embolism of the Blood Vessels, and the Clinical Use of Anticoagulants. Q Bull Northwest Univ. M. School, 1946, 20:1.**

The author traces the history of dicumarol. He states that as great a proportion of patients who are sick with "medical" conditions die from pulmonary embolism as the proportion who undergo operations. About half of all middle aged and older patients who have died after being in bed for varying periods of time have thrombosis of the deep veins of the legs. There is increasing evidence that bland venous thrombosis produces signs and symptoms which may be recognized easily by experienced physicians.

Because the effect of dicumarol is delayed, heparin must be used also when an effect on the coagulation of the blood is desired quickly. Fifty milligrams of heparin are injected intravenously every 4 hours until studies of the prothrombin indicate reduction to a satisfactory value (20%).

Since thromboplastins vary in potency, the prothrombin time should not be used as the basis for regulating dicumarol dosage. The prothrombin should be reported in the percentage of normal. This can be accomplished by a simple method. Normal plasma is diluted with a solution of normal saline solution to produce 90-80-70-60-50-40-30-20-10 per cent of the normal plasma. (The dilutions also represent the percentage of normal prothrombin.) Then the prothrombin time is determined for each of these dilutions. Thus, if the prothrombin time for 20 per cent prothrombin (normal plasma diluted 4 times) were 35 seconds, all prothrombin times of 35 seconds would indicate 20 per cent of normal prothrombin, provided the thromboplastin remained constant. After the prothrombin time for the various dilutions is determined (representing the percentage of normal prothrombin), a curve can be plotted which will indicate the percentage of prothrombin of any plasma for which the prothrombin time has been determined. This curve will allow quick conversion from prothrombin time to percentage prothrombin.

Attention must be given to the thromboplastic substances used, for they vary in potency, and iden-

tical prothrombin times for two lots of thromboplastin may indicate entirely different values for prothrombin (percentage of normal). When the Quick test for prothrombin time is performed repeatedly during treatment with dicumarol, either each batch of thromboplastin must be proved to have the same potency as the former, or a new dilution curve should be plotted for each new batch. The problem has been simplified by the observation that the critical figures in treatment with dicumarol are those representing 10 per cent, 20 per cent, and 30 per cent of the normal prothrombin. One may administer dicumarol adequately knowing only these figures, for clinical experience has indicated that intravascular thrombosis rarely occurs when the percentage prothrombin in the blood is less than 30, and bleeding rarely occurs when the percentage prothrombin is 10 or more.

Three hundred milligrams of dicumarol are given on the first day and 200 mgm. are given on the second day. On each subsequent day of therapy the percentage prothrombin is determined and reported. If the value is more than 20 per cent, 200 mgm. are given; if it is less than 20 per cent none is given. There are minor exceptions to this program. If the patient's blood is sensitive to the effect of dicumarol, only 100 mgm. may be given instead of 200 mgm. If the patient's blood is insensitive to the effect of dicumarol, 300 mgm. may be given instead of 200 mgm. If the percentage prothrombin is decreasing rapidly but is more than 20, no dicumarol is given. If it is rising rapidly, but has not yet quite reached 20 per cent, the drug is given on that day. Ordinarily treatment with dicumarol is continued until the patient has been ambulatory for about a week. The effect of dicumarol ordinarily continues for a few days after discontinuation of treatment. Of course, no protection is afforded against intravascular thrombosis when the prothrombin value for the plasma is between 30 per cent (approximation) and normal.

It was originally believed that vitamin K was ineffective in correcting prothrombin deficiency induced by dicumarol. It is now known that the amounts of vitamin K which were used were entirely inadequate. It has been shown that 64 mgm. of menadiol bisulfite (injected intravenously) corrected excessive prothrombin deficiencies. Transfusion of 500 c.c. of blood, preferably fresh, is also effective; it may need to be given once or twice daily until bleeding stops. If an emergency operation must be performed on a patient who is receiving heparin, the discontinuation for an hour or so will permit the blood to return to a normal state of coagulability. If an emergency operation must be performed on a patient receiving dicumarol, large amounts of vitamin K, and transfusions may be given to return the percentage of prothrombin toward normal values.

The author lists the indications for anticoagulant therapy.

1. For nonfatal pulmonary embolism to prevent further embolism which may be fatal.

2. For thrombophlebitis and phlebothrombosis to prevent further venous thrombosis and pulmonary embolism.

3. For sudden arterial occlusion (embolism and thrombosis) to prevent arterial thrombosis which results from ischemia of the intima (distal to the area of occlusion) and to prevent thrombosis of an artery at the site of embolotomy provided a surgeon removes the embolus.

4. For traumatic injury to the blood vessels to avoid thrombosis.

The author also gives the following possible indications:

1. Prophylaxis against postoperative venous thrombosis (dicumarol only) in cases in which venous thrombosis or embolism have occurred previously, because of the increased probability of further venous thrombosis or embolism.

2. After abdominal hysterectomy (dicumarol only); because 4 per cent of patients who have this operation have postoperative venous thrombosis or embolism and 0.7 per cent die of fatal embolism.

3. In myocardial infarction, congestive heart failure, and cardiac irregularities which predispose to embolism, for the purpose of preventing embolism. (The author has had no experience with patients with these conditions.)

4. Older patients who are confined to bed for long periods, because the probabilities of venous thrombosis and embolism are relatively great (dicumarol only).

The conditions in which anticoagulants are to be used cautiously or not at all are as follows:

1. In cases with vitamin C and K deficiencies or of profound liver disease with prothrombin deficiency, because anticoagulants probably are not needed, and use of them may magnify the tendency to bleed, and with disastrous results.

2. In cases of renal insufficiency because the effect of dicumarol is greatly enhanced by ligation of the ureters of dogs.

3. In cases of blood dyscrasia with impairment of the normal coagulation mechanism, because anticoagulants magnify the tendency to bleed.

4. In cases which have undergone recent operations on the brain or spinal cord, because bleeding in these areas may be disastrous.

5. In cases with ulcerative lesions or open wounds, because of magnification of the tendency to bleed.

THEODORE B. MASSELL, M.D.

## BLOOD; TRANSFUSION

Lerine, P., and Waller, R. K.: *Erythroblastosis Fetalis in the Firstborn*. *Blood, J. Hemat.*, 1946, 1: 143.

The authors note that as a result of studies of the pathogenesis of erythroblastosis fetalis, a new diagnostic procedure, testing for the Rh factor, has been made available. The findings presented indicate that future emphasis should be placed on the prevention of isoimmunization by transfusions in the

group of Rh negative female patients at any time prior to possible pregnancies.

Isoimmunization by the Rh factor occurs in two groups of cases: (1) Rh negative individuals after repeated transfusions of Rh positive blood, and (2) Rh negative women immunized by Rh positive fetal blood. A third group may be mentioned in which both factors, transfusion and pregnancy, are operative.

This paper deals mainly with selected cases of the third group in which isoimmunization was initiated by transfusions and, after a variable interval, became intensified through pregnancies. Evidence is presented which indicates that the combined action of both factors in the order given served to increase the number of infants with erythroblastosis fetalis as well as the severity of the condition in the infant.

Ninety two per cent of all cases of erythroblastosis fetalis result from (1) immunization of the Rh negative mother by Rh positive fetal blood, and (2) subsequent action of maternal anti-Rh antibodies on the susceptible Rh positive fetal blood. The obstetric histories of mothers of erythroblastic infants reveal that this condition occurs in the first born only very rarely. One or more pregnancies with Rh positive infants are required to induce a sufficient degree of isoimmunization. Once an Rh negative woman is immunized, each successive pregnancy with an Rh positive fetus results in increasingly severe forms of erythroblastosis fetalis.

In this study, limited to approximately 700 Rh negative women, only 28 instances were found in which the first Rh positive infant had erythroblastosis fetalis. Of these, 19 mothers gave histories of one or more transfusions at various times prior to the first full term, or almost full term pregnancy, and no such history could be elicited in a control group of 9 mothers.

The findings summarized in Table I seem to justify the conclusion that previous transfusions initiate isoimmunization, which is intensified by the first pregnancy.

Although histological evidence to support a diagnosis of erythroblastosis fetalis was frequently not available, the selection of the cases can now be accepted on the basis of serologic findings in Rh negative mothers who have been immunized, as indicated by the presence of agglutinins or blocking antibodies. These serologic tests were of particular value in cases in which autopsies were not performed or in which the tissues were too much macerated to permit histologic examination.

It is now believed that erythroblastosis fetalis occurs in about 1 of 150 to 200 random full term deliveries. This figure, based on Rh tests to detect all instances of isoimmunization, is to be contrasted with a value of 1 case in 438 deliveries based on clinical grounds only. If all Rh negative women responded readily to isoimmunization, one should expect erythroblastosis fetalis to occur in almost all of the 13 per cent of matings in which the father is Rh positive and the mother Rh negative. At the same



time, erythroblastosis fetalis in the first full term Rh positive infant should occur very frequently.

As the authors noted, it is not possible to obtain a history of intramuscular administration of blood, but in view of its routine indiscriminate use in the past, this procedure must be considered as a possible source of the immunization of Rh negative individuals even in infancy or in the neonatal period. While infants do not produce antibodies as readily as adults, these intramuscular injections may at least serve to initiate the process. In short, it is advisable to avoid this form of therapy in Rh negative women unless Rh negative blood is used.

It is not generally appreciated that the degree of isoimmunization required to induce symptoms of hemolytic disease in the infant is far more intense than that required to produce a severe hemolytic reaction in the mother following the transfusion of Rh positive blood. Now that the pathogenesis of erythroblastosis fetalis is established, it is obvious that the hemolytic disease is the result of prolonged intrauterine action of maternal anti-Rh agglutinins on the susceptible fetal blood. One may expect to find instances of Rh negative women with anti-Rh antibodies who nevertheless have normal Rh positive children, while in the following pregnancy the degree of isoimmunization is sufficiently severe to produce the hemolytic disease.

When the clinical importance of the Rh factor was established, emphasis was placed on the prevention

of intragroup hemolytic transfusion reactions by the use of Rh negative donors for all Rh negative patients already immunized either by previous transfusions or by pregnancies. Now, however, emphasis should be placed on the prevention of isoimmunization.

The deliberate isoimmunization of the Rh negative female population, even as infants, by transfusion or perhaps even by intramuscular injection of Rh positive blood, can now be prevented. This simple measure should, by itself, reduce the incidence of erythroblastosis fetalis, especially in its more severe forms.

The fundamental fact is that once an Rh negative individual is immunized, he or she must be considered as remaining potentially immunized for the remainder of his or her natural lifetime.

In conclusion, the authors note that the incidence of fatal forms of erythroblastosis fetalis in the first-born can be diminished by the simple measure of transfusing all Rh negative female patients, even as infants, with Rh negative blood. Once a female patient is found to be Rh negative, all subsequent transfusions must be carried out with Rh negative blood.

Present indications are that sufficient human anti-Rh serums will become available for the more extensive Rh tests required for the prevention of isoimmunization by transfusion.

HERBERT F. THURSTON, M.D.

**OPERATIVE SURGERY AND TECHNIQUE;  
POSTOPERATIVE TREATMENT**

Cosso, P., and Berreta, J. A.: Anticoagulant Medication with Dicoumarin (La medicación anticoagulante con dicoumarin). *Sem. méd.*, B. Air., 1940, 53: 329.

has induced the authors to report their results in 6 cases treated in private practice and in 10 hospital patients. The preparation was administered orally in doses of 300 mgm. on the first day and 200 mgm. on the second. Dosages during the following days depended upon the results of the tests for the prothrombin time (which should be done daily); the tests were usually from 50 mgm. to 100 mgm., when the above showed a prothrombin which was 25 per cent or infrequent hemorrhages due to excessive dosage. Hemorrhage occurred in only 1 patient in this series, with a bacterial endocarditis and a prothrombin time which had been reduced to 5.5 per cent, and disclosed hemorrhage into the third and fourth ventricles together with small hemorrhagic foci in the kidneys and lungs. The authors state that the transfusion of fresh blood reduces the prothrombin time and is the treatment of choice in the hemorrhagic complications of prothrombin medication. Vitamin K is inefficacious in the hemorrhage. The use of prothrombin medication. be employed in massive hemorrhage. The authors of the 16 cases reported, 7 were diagnosed as acute endocarditis, and in these 7 were diagnosed as such usually employed in the treatment of these hemorrhages and reported in the literature.

of the 16 cases reported, 7 were diagnosed as subacute endocarditis, and in these the dicoumarin was usually employed, and in these the dicoumarin was marked benefit from the anticoagulant therapy. The authors do not claim any benefit in a few instances. However, it was in the cases of thrombosis of the coronary vessels seemed to be more or less at the effect from the anticoagulant was observed; in the patient had a concomitant heart condition from this later. However, in the meantime the immobilization of the affected extremity and the administration of dicoumarin by mouth. The process in another patient was not entirely a was added the painful hardened veins and the patient could finally be up and only a small amount of edema around ankle.

ings of cardiac asthma and the hemoglobin of the red in massive dosages by injection. The dicoumarin was not entirely successful in the treatment of the thrombosis of the coronary vessels. The authors do not claim any benefit in a few instances. However, it was in the cases of thrombosis of the coronary vessels seemed to be more or less at the effect from the anticoagulant was observed; in the patient had a concomitant heart condition from this later. However, in the meantime the immobilization of the affected extremity and the administration of dicoumarin by mouth. The process in another patient was not entirely a was added the painful hardened veins and the patient could finally be up and only a small amount of edema around ankle.

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...ing case of cardiac asthma with electro-  
grams of infarct of the anterior wall of the  
...erved; dicoumarin was administered  
...of preventing the development of a  
...us and apparent benefit resulted. In

another instance with electrographic findings of acute involvement of the pulmonary side of the heart, the attacks ceased permanently after treatment. In a patient with syphilitic aortitis with subsequent peripheral thrombophlebitis and subinfarct the fever disappeared after a couple of days following dicoumarin treatment and the patient has remained well now for 2 months. In a woman who had undergone a subtotal hysterectomy for myoma, a thrombophlebitis in the left internal saphenous vein with fever, pain, and edema of the extremity developed after she had been on her feet for some time; sulfadiazine brought about some improvement but when combined with dicoumarin the extremity disappeared in dramatic fashion. Much the same experience was encountered in a postoperative thrombophlebitis following a subtotal gastrectomy. The authors have not been able to affect the thrombin time with dicoumarin administration.

The author reviewed 129 cases in which the grafts were used by himself or by his associates in the Virginia General Hospital.

The author reviewed 129 cases in which cutis grafts were used by himself and his associates at the Charleston General Hospital, Charleston, West Virginia, and was impressed by the field of usefulness of the cutis graft. The special merits of cutis as a repair material seem to be its pronounced tensile strength and freedom from the tendency to split; it becomes vascularized quickly, and it is gradually transformed into fibrous tissue, and it is gradually made use of cutis tissue whenever the author has used formerly have used cutis lata and wherever, in his opinion, superior results. The author has with regard to the technique, used cutis, and has used soap and water felt, the donor area, and has dressing on it.

With the author's technique, the donor area is prepared with soap and water followed by alcohol and a sterile dressing on the day prior to operation. Shortly before operation an iodine-alcohol preparation is carried out. After a thin epidermal layer is shaved away and the cutis area needed is outlined with a scalpel, the cutis force is picked up at one end with two or three Allis forceps and is removed by undercutting with a short, curved pair of scissors. A fatty tissue is allowed to remain on 1 mm. of thickness of the graft. When a strip of cutis is secured for suspension of the cervix, thick cutis, such as can be obtained from the anterolateral surface of the thigh, should be cut sufficiently wide, from 2.5 to 3 cm., as cutis narrows greatly when put on longitudinal stretch. In repair of inguinal hernia after the Halkett technique the author usually sutures the graft in position under the aponeurosis of the external oblique muscle when reinforcement seems indicated. When cutis is used as suture material,

the author believes it can best be handled with a moderately curved hemostat. The author, finally, uses the removed epidermal layer as a split thickness graft to cover areas from which a cutis graft has been removed. He believes this method is more satisfactory than the undercutting of skin edges to cover the donor area.

The surgical indications for this method of grafting as advocated by the author are: the treatment of incisional hernia, and stage operations in cases of strangulated hernia when the patients' condition does not permit repair of the hernia at the time the strangulation is released, the suspension of the uterine cervix, the ligation of large blood vessels such as the aorta, the reinforcement of certain types of aneurysm, the reinforcement and replacement in the repair of ruptured ligaments of the knee, and chronic recurrent dislocation of the shoulder joint.

The operative mortality was 2.32 per cent and the recurrence rate of hernia 3.2 per cent. There were 2 cases of rather serious wound infection, but the graft was lost in only 1. DAVID H. LYNN, M.D.

Gortchakoff, A. L.: The Treatment of Shock with Serum from Patients with Hypertension. *Vrachebnoe Delo*, 1945, p. 519.

There is experimental and clinical evidence that blood of patients with essential hypertension contains neurohumoral hypertensive substances which stimulate cardiac activity and raise the blood pressure. They exist in the blood a long time before the appearance of the clinical picture of hypertension.

The author studied the effect of serum obtained from patients with hypertension on the isolated hearts of cats and rabbits. Contrary to normal serum, the serum of hypertensive patients markedly increased the cardiac activity. In addition to tachycardia there could be observed an increase of the amplitude of the cardiac contractions up to 400 per cent. Serum from patients with climacteric hypertension had the greatest effect, while serum from patients with hepatic or so-called toxic hypertension had a depressing effect on the cardiac activity.

The next series of experiments was performed on dogs in which peptone shock had been produced. As a rule, the primary fall of the blood pressure was followed by its elevation and the animals perished after the second fall of blood pressure developed. The intravenous introduction of normal serum was not able to prevent the death of the animals, but 3 c.c. of serum from hypertensive patients per kilogram of body weight prevented death in nearly every experiment. Similar results were obtained after a suboccipital introduction of serum.

In another series of experiments traumatic shock was produced either by contusion of the soft parts of the thigh, or eversion and hammering of the mesentery of the small intestine. While all of the control animals perished, 50 per cent of those which were given serum from hypertensive patients survived the experiments. In another series of experi-

ments the trauma of the mesentery in dogs was preceded by the administration of thyroxin with adrenalin in order to accelerate the appearance of shock. Intravenous administration of the serum from hypertensive patients saved 50 per cent of the animals, while the suboccipital mode of administration failed completely. JOSEPH K. NARAT, M.D.

Varco, R. L.: Preoperative Dietary Management for Surgical Patients. *Surgery*, 1946, 19: 393.

This article, the author's thesis for the degree of Doctor of Philosophy, deserves particular attention. Not alone is its literary style unique but the entire problem of preoperative dietary management for surgical patients is evaluated in a scholarly manner. Unquestionably, in part at least, this is due to the fact that emphasis is shifted to include an orientation in the biological sciences included in a surgeon's graduate training. Until recently, accomplishments in dietary care have lagged disproportionately as compared to other progress in the realm of surgery.

A broad zone exists between optimal nutrition and classical deficiency states, and alertness is necessary in order to detect instances of occult inanition. During semistarvation or starvation states, a man survives at the expense of his bodily substance, and suffers from the compound evils of a low protein and high fat diet. Eventually this may evoke hepatic dysfunction, a fatty liver, and hypoproteinemia, which states, if not properly combated, lead to tragedies following surgical manipulations even of minor degree. The mere restoration of water and electrolyte equilibrium and the concurrent adjustment of the hemoglobin to a satisfactory value do not entirely obviate the hazard of subjecting a patient with considerable weight loss to a formidable operative procedure.

Certain aspects of the related literature, dating back to the experiments by Bernard in 1845, are examined and the salient features discerned. This serves to bring into bold relief the role which carbohydrates and proteins, in particular, play in potentiating natural hepatic resistance to deleterious agents. Anoxia is stressed as the causative factor of hepatic dysfunction in the instance of a fatty liver, and it is pointed out that these pathological states are labile and can be reversed under appropriate care.

The author then discusses hypoproteinemia in detail from the standpoint of its genesis as well as of its role in some complications which follow surgical measures. When hypoproteinemia is associated with edema, deliberate development, judiciously extended, of a mild state of dehydration and dechlorination is advised. Our present knowledge as to the fate of ingested protein is reviewed and we are reminded that protein deposition and positive nitrogen balance cannot be obtained unless every essential amino acid is provided.

Therapeutic problems initiated by starvation states are broad and touch on many aspects of the surgeon's sphere of activity. Starvation pyramids

the hazards of surgery, but if good dietary preparation has been achieved, poor risk patients can withstand procedures of almost any magnitude as well as patients in good condition.

From much animal experimentation, diets were prepared which were rich in protein and carbohydrates but reduced in fat content. The author discusses in detail the various diets employed, two of which were administered most frequently. The subject of parenteral alimentation is also well reviewed, particular stress being placed on obtaining a positive nitrogen balance through the agencies of plasma, blood, and amino acids. Nor has the subject of intranasal gastric decompression and feeding been neglected. The instillation of a saline solution of human thrombin into a completely obstructed, bleeding stomach yielded encouraging results.

The author believes that the percentage weight loss is the most important and reliable single criterion by which one can judge the length of time each patient should be prepared nutritionally before operation, although, admittedly, this method is not precise.

DAVID H. LYNN, M.D.

#### ANTISEPTIC SURGERY; TREATMENT OF WOUNDS AND INFECTIONS

Puckett, W. O., McElroy, W. D., and Harvey, E. N.: Studies on Wounds of the Abdomen and Thorax Produced by High Velocity Missiles. *Mil. Surgeon*, 1946, 98: 427.

To investigate the mechanism of wounding by high velocity missiles, the authors have taken high speed motion pictures (from 1,800 to 2,880 frames per second) and microsecond roentgenograms of living cats under nembutal anesthesia during the passage of a particle through the abdomen or thorax. In several instances the alimentary tract was visualized by giving a barium meal before the experiment. The missiles used were  $\frac{1}{32}$  inch steel spheres (mass 0.130 gm.), with impact velocities of 3,200 feet/second, 22 caliber long ammunition (mass 2.62 gm.), and small fragments of 75 mm. shells.

In abdominal wounds produced by high velocity missiles the high speed motion picture studies showed a marked swelling of the abdomen just after entrance. This was interpreted as the development of a large temporary cavity within the abdomen and it persisted from 1.5 to 2 milliseconds. Following this the abdomen underwent a marked constriction, but again expanded, the second time more slowly. These changes in the abdominal cavity volume are purely physical and have no relation to muscular contractions which occurred much later. Comparing pictures of a water filled inner tube during the course of a high velocity particle through it, it was concluded that the abdomen behaved in the same manner as a liquid filled system. These experiments confirmed the earlier work of Callender and French who made observations and pressure measurements on water filled tin cans traversed by high velocity bullets. The phenomena produced were in propor-

tion to the striking energy of the particle, which is determined by its weight and velocity.

Roentgenograms of the abdomen showed that a large temporary cavity was formed immediately after entrance of the abdominal cavity by a missile. By outlining the intestines with a barium meal, it was demonstrated that loops of the intestine were widely separated during passage of the missile and the intestines were flattened by the expanding cavity. The intestines and stomach were altered in shape even some distances from the limits of the temporary cavity. Often the intestine appeared punctured in several places.

Irregular fragments fired into the abdomen varied in several respects. Since the amount of energy imparted to the tissues depends on the cross sectional area of the missile, a large surface causes the missile to give up its energy in a relatively short space rather than to disseminate it equally throughout the entire course. The irregular fragment also changed its course frequently in its passage through the tissues.

Autopsy studies on these abdominal wounds showed the external wounds produced by the spherical missiles to be small, while those made by the irregular fragments were more severe. Internal damage was out of proportion to the small perforations of the body wall. Tears as large as 4 by 6 cm. were frequently found in the mesentery and the cavity was filled by blood if vessels had been severed. Often multiple perforations of the intestine were found at points distant from the missile track. The general effect was that of an explosion taking place within the abdominal cavity.

With respect to thoracic wounds it must be observed that, unlike the abdomen, the thorax is anatomically rigid and air filled in contrast to the soft elastic fluid filled abdominal cavity. High speed motion pictures of the thorax during the passage of a high speed velocity missile showed very little movement of the thorax. Pronounced bulges at points of entrance and exit appeared, but these were limited to the soft tissues and no pronounced volume changes could be seen. Cavity formation would not be expected to be as great in an air filled medium and this is helped by the rigidity of the bony structure. Roentgenograms were not too successful because of the relative radiopacity of the chest structures with the exception of the heart. The heart was temporarily displaced, but no definite cavity was noticed. Autopsy examinations showed that external thoracic wounds tend to remain patent rather than to collapse as the abdominal wounds did. No fractures of ribs occurred at any distance from the missile track although the ribs directly in its path were badly broken. Varying amounts of blood were present according to whether or not major vessels had been injured. The lungs were greatly collapsed, much more so than is usual after a pneumothorax. Although tissue immediately on or adjacent to the path was badly damaged, the residual permanent cavity was never large. This was probably due to

the relative elasticity and sponginess of the pulmonary tissue.

In regard to the physical action of high velocity missiles traversing the abdominal and thoracic cavities, it must be remembered that any high speed particle passing through a medium imparts a certain amount of its energy to that medium and causes it to move away from the missile track. This radial displacement of the medium causes the formation of a rapidly expanding cavity immediately behind the missile which contains a negative pressure. When the tissue inertia is overcome, the external atmospheric pressure responds by collapsing this cavity completely and constricting the abdomen. This is followed by a second bulging of the abdomen of longer duration, but of less intensity. These are essentially the reactions of a fluid filled rubber tube or water can to a high speed particle. The formation of the large temporary cavity results in rapid pressure changes in the adjacent areas. The first of these, the "positive pressure pulse," is of short duration, no longer than  $\frac{1}{4}$  millisecond. Because of the heterogeneity of the tissues within the abdominal cavity, actual records made by piezoelectric crystal gauges show several pressure peaks rather than a single one as is observed in water filled tubes and cans. Because of the rapid radial displacement of tissues about the missile course, secondarily there is a period of negative pressure in the medium about the cavity. This period of lowered pressure may have serious effects on the tissues. Gas masses increase in volume and multiple perforations of the intestine are probably due to this. To investigate this, a ring of cat colon was filled with saline solution and placed in a tank of saline solution. Two bubbles of air were injected into the colon. A high speed bullet was fired through the ring and motion pictures were made. At first there was a slight constriction of the air bubbles, only to be succeeded by a marked swelling of the intestine in the region of the bubbles. Rapid pressure changes are important factors in producing wounds.

In summary, the following phenomena occur in abdominal and thoracic wounds produced by high velocity missiles. The abdomen swells immediately after the passage of a missile. This persists for 1 or 2 milliseconds and is followed by a constriction lasting 4 or 5 milliseconds. This is succeeded by a second bulging of the abdominal walls of greater duration, but less intensity. These movements are dependent for their rate and magnitude on the striking energy of the particle. Coincident with the initial abdominal expansion there is a large temporary cavity inside the abdomen. Internal damage to the viscera is far out of proportion to the wounds of exit and entrance. The general effect is that of an explosion within the abdomen. Irregular missiles vary their behavior in accordance with the projected area as they strike. No volume changes occur within the thorax. This is due to the rigid skeletal thoracic cage as well as to the contained air.

C. FREDERICK KITTLE, M.D.

Cameron, G. R., Allen, J. W., Coles, R. F. G., and Rutland, J. P.: Acceleration of Healing by Pressure Application to Experimental Thermal Burns. *J. Path. Bact.*, Lond., 1946, 53: 1.

The prompt application of pressure bandages to thermal burns of the extremities of goats accelerates the rate of healing and greatly reduces the mean healing time. The pressure interferes with the effusion of plasma and the formation of fibrin at the burn site decreases the amount of reparative tissue, and probably decreases the chance of local infection.

Pressure should be applied as soon as possible after burning to get the best results. A delay of 4 hours is probably the limit for beneficial effects.

There is no need to maintain the pressure application for much longer than a week, for there is very little difference in mean healing times of standard burns treated with pressure for 9, 16, or 30 days. Removal of the pressure bandages during a critical phase lasting for several days after burning is followed by severe edema of the burned area and delay in healing.

SAUEL KARY, M.D.

Pavlovsky, A. J., Oghl, A., and Harris, M. M.: The Sequelae of Burns; Treatment with Skin Grafts (Quemaduras: sus secuelas; tratamiento por los injertos libres de piel). *Rev. As. med. argent.*, 1945, 60: 78.

Some raw surfaces resulting from burns have been treated by means of skin grafts. Two types of cases are considered: the immediate, presenting a loss of substance, and the late, presenting keloid and scar formation.

Raw surfaces are generally not treated by grafting early unless the receptive wound is clinically prepared to receive the graft, as the chances of failure are great. A wound covered with flat, granulation tissue without active bleeding is the most favorable for grafting, otherwise this procedure is contraindicated.

Bacteriological studies were omitted in as much as practically all plastic surgeons agree that absolute sterilization is almost impossible and that wounds covered by adequate granulation tissue are favorable to grafting even in the presence of mild infection. Daily treatments with gauze impregnated with cod liver oil were made, and alternated with the application of sulfonamides for a period of 2 days. When the wound was ready, saline dressings were applied. As a rule, granulation tissue was curetted during the operation except in the cases in which the wound was greatly infected and responded poorly to the treatment as outlined. Preference was given to the sulfonamide compounds which incorporated "allantoin" in powder or ointment form.

The treatment of the late sequelae of burns consisted of the removal of all scar tissue interfering with free motion of the parts involved and until with free motion were encountered. Only the most sound tissues were ligated and sutures were used sparingly to avoid foreign body reactions. The resulting wound is generally ready for grafting.

at once; otherwise it is powdered with sulfonamides and covered with aseptic gauze. At the end of from 6 to 8 days the wound is ready for grafting.

Donor areas are generally selected from the anterolateral aspect of the thigh inasmuch as technically it is the best location for obtaining thin grafts. This location has not, however, been satisfactory because such areas frequently become dark in color and even may form keloids. At times, grafts have been obtained from the buttocks. Better epithelization takes place in spite of the supine position. At any rate, if there is keloid formation the area is a concealed one. Once the graft is obtained, the donor area is covered with saline dressings after it is powdered with sulfonamides. As a rule, from 12 to 15 days later the area is healed.

The grafts have always been obtained by means of the Padgett's dermatome or a copy of the original. A liquid preparation made by Dunlop mixed with a third of its volume of ether just before it is applied has been used as an adhesive. The impression has been gained that the preparation is more adherent when used this way.

The use of small sutures to fix the graft has been given up and the procedure used by M.E. Sano (*Surg., Gyn. Obst.*, 1943, 77:510) has been adopted. The plasma and thrombin extracts were obtained by the authors from the patient's own blood.

With the help of a camel's hair brush, plasma is spread over the wound, and the graft is spread with thrombin extract while it is still adherent to the dermatome. The authors believe that the results of the method have been satisfactory and intend to try the method further. They believe that both thin and thick grafts take well but prefer the relatively thick ones (from .6 to .8 mm. thick) because the thin ones have a tendency to develop phlyctenular areas which become infected later.

F. F. REMY, M.D.

Gordon, J., Hall, R. A., Heggie, R. M., and Horne, E. A.: A Histological and Bacteriological Study of Healing Burns with an Inquiry into the Significance of Local Infection. *J. Path. Bact.*, Lond., 1946, 58: 51.

A small series of second and early third degree burns has been examined in detail, with the method of biopsy to assess the extent of the initial injury and to determine the mode of healing.

Epithelization of second degree burns takes place multifocally from the viable epithelial cells lining the sweat ducts and hair root follicles. There appears to be no latent period during this process.

In pure second degree burns healing can occur in the presence of the hemolytic streptococcus and the staphylococcus aureus, singly or together, with little if any retardation.

If infection becomes established in the third degree areas of mixed second and third degree burns, the healing of the neighboring second degree areas is quite frequently delayed.

JOHN J. MALONEY, M.D.

Saarenmaa, E.: On Clostridia Infections in War Wounds on the Karelian Isthmus. *Acta chir. scand.*, 1946, 93: 363.

The observations, presented by the author are based upon experiences in field and evacuation hospitals during the wars on the Karelian Isthmus between 1940 and 1944. Clinically, no cases of gas edema involving the head, throat, chest wall, or upper extremities were observed. In the lower limbs, however, numerous gas-containing infections appeared in connection with traumatic ischemia. Only in 2 rapidly fatal cases, not studied bacteriologically, was the site other than the lower extremities. In one of them gas infection resulted from a splinter penetration of the lung tissue and produced "pressure pneumothorax"; in the other, gas edema developed in the abdominal wall after an operation for a wound in the abdomen. No division into "brown" or "blue" forms of gas edema was observed. From August, 1944 to the Armistice, gas-containing wound infections were examined bacteriologically in 5 cases and in all of them the pathogenic clostridium was found. Specimens were taken through undamaged skin from gas-containing tissues. In 3 instances the infection was monomicrobial.

The case reports cited are examples of three different types of disease: (1) a case of empyema due to clostridium septicum in which pressure pneumothorax developed and recovery followed operation; (2) gas edema due to the clostridium welchii and a strain not closely identified, and contusion of the muscle tissue (2 cases); and (3) far advanced gas edema due to the clostridium welchii affecting the lower extremities in which traumatic ischemia was simultaneously present (2 cases); immense gas edema at the site of a splinter embolus in a posterial tibial artery as the result of a splinter which entered the left axilla and penetrated the lung tissue and the left ventricle of the heart (1 case which terminated in death). Except in combination with traumatic ischemia, malignant gas edema was very uncommon on the Karelian Isthmus.

Traumatic edema must be considered the most important predisposing cause of gas edema. This should be kept in mind when plaster dressings and tourniquets are applied as they may cause the gas edema to break out when the virulence of the clostridia is slight. Gas edema may occur in mild forms as shown by the presence of pathogenic clostridia and histiolysis of muscle. Whether routinely administered tetanus antitoxin contributed to a decrease in virulence is uncertain. In the diagnosis, roentgenograms aid in the differentiation between the gas edema, gas abscess and gas-containing phlegmons

WALTER H. NADLER, M.D.

Kogan, I. S.: The Therapy of Infected Wounds and Acute Infections with Immunotransfusions. *Vrachebnoe Delo*, 1945, p. 147.

The author describes immunotransfusions as a method of active stimulation of the mesenchyma of the reticuloendothelial system. The treatment

should be instituted as soon after infection has occurred as possible, especially if the wound is extensive and soiled. Wright introduced the method of immunotransfusion in 1919 for the purpose of raising the resistance of the body by passive immunization.

The author studied the possibility of not only antimicrobial but also antitoxic and mixed immunity. He accumulated experimental and clinical evidence that it is possible within 3 days to create a marked increase of immune bodies in the donor's blood and to preserve them for from 10 to 12 days. The increase of immunity may last a month if a prolonged method of immunization is used.

A diminution of the minimal osmotic resistance of the erythrocytes may be considered as an index of an intensified production of young erythrocytes. Conversely, an increased maximal resistance of the erythrocytes indicates an aging process of the blood. According to the author's observation, immunotransfusion was followed by a fall of the minimal resistance of erythrocytes, which demonstrated the stimulating effect of the transfusion.

Increase in the number of thrombocytes, demonstrating a stimulation of the bone marrow, was one of the results of immunotransfusions.

The author performed a sternal puncture on 25 patients with various septic, suppurative processes and found that immunotransfusions were followed by a stimulation of erythropoiesis or, less frequently, leucopoiesis. The number of cells of the erythroid group increased, while the number of the least ripe myeloid cells and plasma cells diminished.

The index of cellular and humoral immunity increased following immunotransfusions. This observation also demonstrated the stimulation of immunogenesis in patients with septic conditions. The number of phagocytes, the opsonic index, and the agglutination titer were determined in order to study the effect of immunotransfusions.

The dynamics of reticulocytosis were studied in patients with septic conditions before and after immunotransfusions because reticulocytosis serves as an index of the intensity of the regenerative processes, especially medullary erythropoiesis. As a rule, the number of reticulocytes increased following immunotransfusion.

The functional condition of the reticuloendothelial system may be evaluated by the study of histiocytosis. The author studied lymphohistiocytosis before and after immunotransfusion in blisters produced by cantharides. A definite relation between the immunobiologic, reactivity of the organism and the intensity of proliferation of histiocytic formation definitely exists. The author's observations demonstrated the stimulating effect of immunotransfusion which was followed by an increased number of lymphohistiocytes. The author's observations on more than 500 patients definitely established the stimulating effect of immunotransfusion. A passive immunity may be produced in the recipient by the transfusion of blood from an im-

munized donor. The passive immunity lasts approximately 3 weeks. The transfused immunized blood acts as a stimulus for immunogenesis in the recipient. The immunized blood, more saturated with proteins than the regular blood, produces a more intensive colloidalolysis. The bactericidal power of the blood and tissues rises under the influence of immunotransfusion. Finally, the immunized blood diminishes the allergy of the organism.

JOSEPH K. NART, M.D.

Hudson, R. V., Meanock, R. L., McIntosh, J., and Selbie, F. R.: Penicillin Therapy: Clinical and Laboratory Observations of 400 Cases. *Lancet*, Lond., 1946, 1: 409.

Of the 400 cases reported, 20 were severe injuries in which the penicillin was used as a prophylactic agent; 380 were cases of acute or subacute established infections. Two hundred and forty-two patients were treated with systemic, 46 with systemic and local, and 92 with local penicillin. Of the 288 cases treated with systemic penicillin, 188 were surgical and 100 medical infections.

In the surgical group there were 8 failures and 11 deaths; in 162 patients, an apparently complete recovery was obtained, while in 7, the acute lesion was reduced to that of a chronic infection.

In the medical group, there were 61 apparently complete recoveries, 11 deaths, and 15 failures. The deaths were due to the severe complications present at the outset of treatment, or to under-dosage.

Actinomycosis and persistent infections of the deeper tissues of the eye proved most resistant to treatment. In systemic therapy a dose of 60,000 units, injected intramuscularly every 3 hours during the day and night, was found to be the most satisfactory. The duration of treatment varied from 1 to 38 days.

In traumatic surgery, the extirpation of avascular tissue was essential to penicillin therapy.

In established infections, of the several methods tested, two proved satisfactory. When penicillin had converted the acute lesion to a chronic one, a small incision and temporary drainage were all that was necessary or advisable in the majority of cases, but in a minority of the cases, and for specific reasons, the radical removal of all visibly infected material, followed by primary suture and temporary drainage, gave uniformly satisfactory results. Whichever method was employed, it was essential to continue penicillin for a time long enough to control the residual infected tissue.

Local administration was valuable in surface lesions; with local therapy, 61 patients were cured and 23 were not benefited. In all other infective lesions, systemic therapy proved the most satisfactory method, and, with the exception of meningitis and possibly empyema, supplementary local penicillin therapy was unnecessary.

Penicillin therapy has been a particular advance in the control of infections with staphylococcus aureus, streptococcus viridans, and the sulfonamide-

resistant gonococcus. The successes obtained have been due to maintaining a concentration in the tissues of sufficient strength and for sufficient time to enable the patient to utilize his natural defenses to the full. An apparent cure has been obtained in cases in which the patient has been able to localize his infection so that he can absorb necrotic tissue, spontaneously extrude pus or dead tissue, or provide safe conditions to enable the surgeon to assist recovery by removing dead tissue.

WALTER H. NADLER, M.D.

Twining, H. E., Dixon, H. M., and Weldman, F. D.: *Penicillin in the Treatment of Madura Foot; Report of 2 Cases. Nav. Med. Bull., 1946, 46: 417.*

Two cases of madura foot are reported. In both cases the disease was contracted outside of the tropics. The fungus species concerned were among the rarer causes of madura foot—the monosporium aplosporum and the cephalosporium granulomatis.

The results of penicillin therapy differed in both cases. In one, the disease had progressed to the development of osteomyelitis and, although an apparent cure was achieved at first, relapse occurred and amputation had to be done even though the penicillin was administered over a relatively long period of time (27 days). In the other case only the soft tissues were involved, and at the end of 8 months the cure appears to be permanent.

Although there appears to be a parallelism between madura foot and actinomycosis, in regard to the possible value of penicillin therapy, no generalization can be made at the present time. Certainly, it cannot be made to include the entire group of deep mycoses, in view of the recalcitrance of coccidioid granuloma and blastomycosis. It is even unreasonable to expect penicillin to be uniformly efficacious in madura foot, since this condition is a clinical entity in which no less than 8 genera and 30 species of fungi have been listed. The value of the penicillin will depend on the causative agent in each case. The necessity for precise mycological determinations in future studies of the value of penicillin in madura foot is, therefore, evident. SAMUEL KAHN, M.D.

### ANESTHESIA

Tainter, M. L.: *The Frontiers of Anesthesia. Anesthesiology, 1946, 7: 132.*

There are two ways in which medical developments come into practical acceptance. The first unspectacular but perhaps quantitatively most important method is the continuous slow accumulation of bits of knowledge which insensibly modify the current practices day by day. The other type of progress is discontinuous, with a slow accumulation of disconnected and uncorrelated facts. Suddenly a dramatic incident fires the imagination and there is a rush to translate this dammed up store of knowledge into an entirely new concept of practice.

So it was with anesthesia at the time we consider the period of its discovery. Probably there were

numerous other experiences in the production of anesthesia, but these went entirely unnoticed for the lack of sufficient enthusiasm and of the prepared mind.

The antagonism to the then new procedure reveals the resistance which a valuable new concept oftentimes has to overcome before it gains general acceptance.

There have been many episodes similar to this in which sudden realization of the significance of a phenomenon, previously known to many, has resulted in an abrupt change in some phase of medical practice.

We are all on the frontier of medical progress. The time when a new frontier is to be crossed is largely up to our research scientists, but it also devolves on others to play their roles by seizing on new information and transforming it into practical clinical reality.

In recent times there has been renewed interest in the development of anesthetic agents of increased potency which might have an increased margin of safety. In the field of general anesthesia there are many desiderata which can be hoped for. A gaseous agent, of high potency, which is nonexplosive and with the predilection for depressing the neuromuscular system more than the sensory apparatus is desirable. The new ideal anesthetic would have no power to increase the irritability of the heart. Another field of development which needs more extensive exploration is that of intravenous anesthesia. There is no reason why, if the anesthetic agent has a short enough duration of action, it might not be possible to control anesthesia administered intravenously as flexibly as is now the case with gas anesthesia. We know now that certain substances protect the liver from damage by fat soluble materials, such as chloroform, and that procaine could be used intravenously to minimize the possibility of acute cardiac failure.

In the field of topical anesthesia, an anesthetic is needed which passes more readily through the surface to get at the nerve endings beneath. Such an agent should not be unduly irritating to the tissues locally or hazardous after systemic absorption. Another need is for a local agent which will penetrate the unbroken skin. An incompletely explored approach to this problem is possible with the use of new synthetic vehicles which may lead to increased penetrating power.

Fifty years of research have not succeeded in the creation of a local anesthetic capable of displacing procaine from the dominant position it holds as an injection agent. We need an agent which will produce prompt anesthesia at lower concentration without an increased toxicity proportionate to the greater anesthetic potency. Longer duration of the anesthesia is always a desirable property. Another desideratum for a spinal anesthetic solution might be "diminished diffusibility." The role of vasoconstrictors has not been adequately explored. Attention might also be directed to developing an antidote for the local anesthetic whereby the anesthesia could be



terminated at will. The optimal anesthetic solution for the use of caudal anesthesia in obstetrics has not been developed despite intensive studies.

There would seem to be a very definite field for the development of new analeptic drugs which have the power of stimulating the respiratory mechanism without risking at the same time the potentiality of convulsive after effects. The need is for a compound which does not cause increased utilization of oxygen by the tissues.

A relative of epinephrine—ethylnorsuprarenin—is worthy of considerable study in the field of resuscitation of the circulation as it has the power to augment the force of contraction of the heart, but dilates the arterioles so that the heart is able to pump the blood against a lowered mean peripheral resistance.

These general comments on the types of improvements that may be sought in the field of anesthesia have been made in the hope that they will stimulate the medical profession to accept the new developments as they come along and thereby hasten their transfer from the field of speculation to reality.

MARY FRANCES POE, M.D.

**Burstein, C.: Treatment of Acute Arrhythmias during Anesthesia by Intravenous Procaine.** *Anesthesiology*, 1946, 7: 113.

In a series of 14 anesthetized patients with acute arrhythmias during intrathoracic operation, single doses of procaine ranging from 30 to 70 mgm. were injected intravenously. No deleterious effect was observed; on the contrary, cardiocirculatory improvement was often effected. Three case reports, 1 with electrocardiographic tracings, are presented.

Cardiac hyperirritability may be expected during the course of surgical intervention upon the heart. Direct stimulation of sensitized cardiac tissue, and other accessory factors are to be considered.

The preponderance of dysrhythmias from pericardial stimulation is probably explained by the fact that the pericardium is richly supplied by a plexus of nerve fibers. Other factors which may contribute to cardiac hyperirritability are the psychic emotional state of the patient, the anesthetic agent, the method employed, and the injection of certain drugs. Endotracheal intubation may cause cardiac disturbances through a vagovagal reflex. This reflex is particularly dominant when the anesthetic agent used is itself cholinergic. Spraying the larynx with 10 per cent cocaine prior to intubation is recommended to obviate such vagotonic effects. The administration of analeptics should be carefully weighed in acute cardiac emergencies. Whatever stimulating properties they may have in the unanesthetized state may be lost during anesthesia, and further, these drugs may increase respiratory and circulatory depression.

The use of procaine during anesthesia to diminish cardiac irritability is based upon experimental findings that procaine applied locally to the heart reduces irritability of the myocardium, and that the

injection of procaine protects against the development of ventricular fibrillation during chloroform anesthesia, and against cardiac arrhythmias during cyclopropane anesthesia produced by epinephrine. It is confirmed that arrhythmias with pacemaker derangements can be reverted to the sinus node by procaine. This report shows that even when ventricular fibrillation has set in during cyclopropane anesthesia, the intracardiac injection of procaine may be followed by a return to sinus rhythm. General anesthesia probably affords specific protection against the stimulating action of procaine on the central nervous system.

In all these cases the procaine solution was injected rapidly into one of the large antecubital veins of the arm. Whether the direct intracardiac injection is to be preferred is as yet undetermined. Further studies are needed to determine the optimal dose.

MARY FRANCES POE, M.D.

**Cavalcanti, J.: Hypotension and Spinal Anesthesia. The Veritol Test (Hipotensão e ra-quianestesia. A prova do veritol).** *Brasil med*, 1945, 7: 465.

Hypotension represents one of the sequelae of major importance following spinal anesthesia.

Two main factors are responsible for the fall of the blood pressure following spinal anesthesia: (1) blocking of the vasomotor system, with a resulting dilatation of the blood vessels in the somatic as well as visceral area, and (2) paralysis of the intercostal muscles which diminishes the respiratory excursions and interferes with the return of the blood to the heart.

To counteract this hypotension caused by spinal anesthesia the author discontinued the use of epinephrine and cardiazol-epinephrine and replaced these drugs by veritol which gives more satisfactory results. The author also recommends the veritol test, which is performed in the following manner:

After the systolic and diastolic pressures and the frequency of the pulse have been recorded, 1 ampoule of veritol is injected intramuscularly. Three minutes later the blood pressure and frequency of the pulse are again recorded. If the arterial pressure rises and the frequency of the pulse remains unchanged, the test is considered positive and it indicates a good reaction of the vasomotor system. If, however, the arterial pressure following an injection of veritol does not undergo any modification and the pulse frequency rises, the test is considered negative and serves as a contraindication to spinal anesthesia.

JOSEPH K. NARIT, M.D.

**Cole, F.: A New Lethal Dose of Curare, with Some Observations on the Pathology Produced by Large Doses.** *Anesthesiology*, 1946, 7: 120.

In view of the widespread use of curare today in anesthesia and neurology, a study seemed advisable to determine (in the laboratory animal) whether or not very large single doses of this drug could be harmful in the presence of adequate pulmonary

ventilation, what the harmful effects might be, and possibly what a new lethal dose of curare might be when there is no association with a preventable anoxia. Intocostrin was used throughout.

The anoxic lethal dose was found to be 0.065 c.c. (1/15 c.c.) per pound in the dog. On the injection of curare directly into the vein, the anoxic lethal dose was shown to be unaffected by cyclopropane oxygen anesthesia, with which curare is commonly administered in man.

The possibility of a cumulative effect of curare is indicated by the death of a dog following the administration of what appeared later to be a sublethal dose. It is suggested that the use of curare on succeeding days may be associated with a heightened effect of the drug.

An unidentified anticurare effect was encountered with the technique of tracheal intubation, cyclopropane-oxygen anesthesia, pentothal induction, and the administration of curare with saline solutions through rubber tubing. A solution to the phenomenon was not essential for the purpose of these experiments but it might explain variations in the curare effects in man, and might be a clue to an anti-curare mechanism which could be useful in terminating the effect of an overdose of curare. The sudden deaths of 2 dogs after apparent complete recovery suggest that the animals were in a dangerous state on emergence from the deep curarization.

There is a nonanoxic lethal dose of curare. Dogs can make complete recovery, with artificial respira-

tion, after receiving five times the anoxia lethal dose of curare, or 0.33 c.c. of intocostrin, per pound of body weight. Complete recovery was made in 1 case following the administration of 1 c.c. of intocostrin per pound (fifteen times the anoxic lethal dose); artificial respiration was maintained for 18 hours. Prostigmine does not appear to be a perfect neutralizing agent for large doses of curare.

Bronchiole or intercostal spasm is suggested as occurring immediately following the injection of large doses of curare because of the greater amount of force required to raise the chest wall during artificial respiration. A temporary unavoidable cyanosis following the administration of large doses of curare, in the presence of proper artificial respiration, may be due to this respiratory spasm or to a pro-cardiovascular system appears to be affected by large doses of curare. Marked slowing of the pulse rate occurred whenever artificial respiration was stopped.

No clinical evidence of brain damage could be found other than that due to anoxia.

Bloody diarrhea was a constant finding in the later experiments, in which very large doses of curare were used. Postmortem examination in 2 cases revealed the presence of severe mucosal hemorrhages involving the entire intestinal tract. There may be at least a relative contraindication for the use of large doses of curare when there is a disease of the intestinal tract.

MARY FRANCES POE, M.D.

# PHYSICO-CHEMICAL METHODS IN SURGERY

## ROENTGENOLOGY

Whiteleather, J. E., Semmes, R. E., and Murphey, F.: The Roentgenographic Signs of Herniation of the Cervical Intervertebral Disc. *Radiology*, 1946, 46: 213.

The authors describe herniation of the cervical disc as observed roentgenographically in 32 cases verified by operation, and 106 additional cases not verified but presenting the same clinical and x-ray findings.

The two divisions of the spine which undergo the greatest stress are the lower lumbar and lower cervical segments. One might expect to find degenerative disc changes in these regions more commonly than elsewhere, and this is clinically true. The only significant difference is that in the cervical region the spinal canal and intervertebral foramina are smaller than in the lumbar spine; hence, a small herniation is more likely to be symptomatic. In addition, the nerve roots in the cervical region emerge from the dura at right angles and are compressed as they pass through the intervertebral foramina, while in the lumbar region the angle of emergence is acute and the roots are compressed against the vertebra above their exit from the canal.

Lateral herniation of the cervical disc usually follows a relatively slight trauma, although some patients are unaware of any specific injury. Not all displacement of disc tissue results in clinical symptoms. The lesions which produce nerve root compression are of two types:

1. Extruded nodules of nucleus pulposus which are soft and radiolucent but are easily recognized when the posterior ligament is incised. These later undergo ossification and, becoming visible, are often interpreted as arthritic spurs.

2. Protrusions of the disc with neither rupture of the annulus fibrosus nor extrusion of the nucleus pulposus. Ossification occurs in the late stages of this type also.

The first symptom is usually stiffness of the neck with pain radiating to the occiput. This may disappear or recur at intervals if the degree of injury is slight. After a period of days, months, or years, pain may be felt in the shoulder, over the anterior chest wall, the medial border of the scapula, and down the arm, frequently accompanied by sensory changes in one or more fingers. The chest pain may be so severe that the patient believes he has suffered a heart attack. It may be so mild as to stimulate myalgia, neuritis, bursitis, or arthritis of the shoulder. Movement of the neck, coughing, sneezing, and straining may aggravate the symptoms. Supporting the arm or sleeping with it behind the head may relieve them. The patient may complain of numbness and tingling in the thumb or fingers or a feeling as of an electric shock running down the arm.

Weakness of the grip, vasomotor changes, and, in the late stages, muscular atrophy may be observed.

The head may be carried tilted to one side with the neck extended; muscle spasm and limitation of motion may be present. The patient has a tendency to protect himself against sudden jars and against untoward movements. Of considerable diagnostic importance is the elicitation of point tenderness over the affected nerve root by compression or percussion. A positive "neck compression test" is almost pathognomonic.

The lesion is localized by correlation of the clinical and roentgenographic findings. The distribution of pain and sensory changes and the condition of the tendon reflexes are practically specific. The abnormalities observed on the roentgenograms are:

1. Loss of reversal of normal cervical lordosis, either complete or segmental
2. Narrowing of the intervertebral space
3. Calcified particles of the disc (osteophytes) and proliferative spurs projecting into the foramina and from the anterior margins of the bodies
4. Alterations in size and shape of the foramen
5. Decreased mobility
6. Defects in the myelogram

None of these findings is considered pathognomonic, as some may be present without sufficient nerve injury to produce symptoms. However, when they are correlated with the history, symptoms, and neurological findings, they are highly confirmatory.

Myelography is a fairly accurate diagnostic procedure when carefully done and correctly interpreted.

At present, there is some doubt as to whether the diagnosis of herniated cervical disc can be made more accurately by myelography than by clinical means and standard roentgenograms.

There is much yet to be learned about the treatment of ruptured discs in any part of the spine. Excellent results have been obtained, however, in the early or soft lesions by partial hemilaminectomy and removal of the extruded particles.

Conservative treatment, such as traction and physiotherapy, is first given a trial and frequently affords relief. Operative treatment is reserved for those who do not respond to less radical measures.

HARRY FINE, M.D.

Epstein, B. S., and Davidoff, L. M.: The Myelographic Diagnosis of Extramedullary Cervical Spinal Cord Tumors. *Am. J. Roentg.*, 1946, 55: 413.

The authors report the myelographic findings in 5 patients with extramedullary tumors of the cervical spinal cord or nerve roots, in whom the direct roentgenograms remained negative.

In conjunction with these cases, they describe in detail the technique of myelography for visualization.



Fig. 1. Left, Spot roentgenogram of lower cervical canal revealing normal configuration of the pantopaque column. Right, Spot roentgenogram of oil column in upper cervical spinal canal revealing filling defect on the right at the level of the upper three cervical segments. Perineural fibroblastoma found at operation.

tion of the cervical spinal canal. A standard motor driven tilt table is used which is equipped for roentgenoscopy and spot film roentgenography. The authors inject only 3 c.c. of pantopaque oil into the lumbar subarachnoid space whereas others use 6 c.c. of oil, preferring to aspirate it after examination. The patient is placed on his stomach with his head turned to one side. First the table is tilted slightly caudadward so that all the oil gathers in the lumbar sac, then it is tilted slowly in the opposite direction until the head reaches 10 degrees below the horizontal.

During this maneuver the passage of the oil is carefully observed roentgenoscopically. The column usually halts at the level of the first lumbar vertebra. By requesting the patient to strain it will advance another 3 or 4 cm. At this point the patient is asked to assume the knee-chest position gradually and the oil will pass through the thoracic canal. When the upper dorsal region is reached the patient is returned to the prone position and the table is tilted slightly caudadward. The oil is then permitted to collect in the lower cervical canal. From here on the column assumes a transitory "U" configuration splitting into two lateral ribbons of greater density between which the remainder of the oil collects. Persisting filling defects confined to one region in the presence of good visualization of the other pouches

are considered indicative of cervical spinal cord tumors (Fig. 1). Patients with kyphosis or scoliosis of the thoracic spine are examined in the lateral position. Sometimes it is impossible to prevent the passage of the pantopaque oil into the basilar cisterns. A prompt reversal of the tilting will get the oil back into the cervical spinal canal, permitting at the same time the observation of the descent in a manner similar to that following a cisternal instillation.

The 5 cases are presented in detail and their roentgenograms reproduced. The duration of the symptoms varied from 4 months to 2 years. The onset was always insidious. Four of the patients complained of pain in the right shoulder, in 2 there were symptoms referable to the lower extremities, and 1 patient had a complete tetraplegia. The pattern of pain showed no regional characteristics but varied with the results of the pressure produced in each individual.

The most important finding in the cerebrospinal fluid was an increase of the protein content. In 2 cases there was a complete fluid block, in 2 a partial block, and in 1 case there was no block. Three of the tumors were perineural fibroblastomas and 2 were meningiomas. All were extramedullary and could be removed with complete recovery of the patients.

T. LEUCUTA, M.D.

Hodson, C. J.: *The Localization of Foreign Bodies in the Chest. Brit. J. Radiol.*, 1946, 19: 70.

The author's report is based on the method used at an Army Chest Center where 200 cases were observed at operation. It was the belief and policy that all foreign bodies retained within the rib plane or the thoracic cavity, measuring over 1 centimeter in any one direction, should be removed provided the operating risk appeared reasonable. Stress was laid on the importance of close co-operation between the radiologist and the surgeon.

The surgical approaches, determined by the site of missile, pleural pathology, etc., were: (1) lateral thoracotomy, (2) anterior thoracotomy, (3) posterior or parascapular thoracotomy, and (4) local approach.

The localization was by radiography, fluoroscopy, or both. Anatomical localization, rather than skin markings, was emphasized. Tangential fluoroscopy was indicated particularly in the so called "blind" areas (most of the chest wall, the apical, paramedias-tinal, and diaphragmatic regions).

The localization of missiles in the following regions was described in more detail:

1. Peripheral foreign bodies. Needle localization was usually the method of choice. The possibility of the incorporation of the foreign body within callus was stressed.

2. Mediastinal foreign bodies. Localization was usually best done from films. The superior mediastinal localization usually required both films and fluoroscopy; occasionally esophageal identification with barium and tracheal outline with lipiodol were necessary.

3. Posterior mediastinal foreign bodies were marked by vertebral level and their relation to the aorta, trachea, and esophagus.

4. Paradiaphragmatic foreign bodies required aspiration of effusions and, when possible, expansion of the lower lobes before localization. Movement of the diaphragm in relation to the foreign body offered considerable assistance. Induced pneumoperitoneum was of little value.

5. Para- and intracardiac foreign bodies. Fluoroscopy was the method of choice for both large and especially small foreign bodies.

6. Intrapulmonary foreign bodies. Films usually sufficed, although "blind" areas required tangential screening.

R. B. Lewis, M.D.

Benedict, E. B.: *Correlation of Gastroscopic, Roentgenologic, and Pathological Findings in Diseases of the Stomach; An Analysis of 245 Proved Cases. Am. J. Roentg.*, 1946, 55: 251.

In the present analysis of 245 cases of diseases of the stomach, the author emphasizes the importance of co-operation between the roentgenologist, the gastroscopist, and the pathologist. Gastroscopy is supplementary and complementary to roentgenology, but is not a rival method. A group of 245 carefully selected cases was chosen for this study. In each of these there has been a roentgen examination, a gastroscopy, and a pathological report. The

cases included carcinoma (125), gastric ulcer (50), duodenal ulcer (25), jejunal ulcer (8), gastritis (16), benign tumor (7), lymphoma (5), sarcoma (3), metastatic carcinoma (3), and normal stomach (4).

In the 125 cases of carcinoma, the roentgen examination and gastroscopy were equally good 67 times, equally doubtful 3 times, and equally wrong 3 times. In the remaining 52 cases roentgenology proved the better method 32 times, and gastroscopy, 20 times. In 25 of the 32 cases in which the roentgen ray was more valuable, gastroscopy failed to demonstrate the lesion at all. The reasons for the failure were mechanical difficulties such as the inability to see lesions of the lesser curvature of the antrum, pyloric area, and pylorus, especially if they were hidden around the corner behind the angulus, or of the fundus if they were located high up in the blind area toward the lesser curvature, or, finally, if the secretion of the stomach was excessive. In the other 7 cases the causes of failure were manifold. The cases and the results of the examinations are briefly described.

The 20 cases in which gastroscopy appeared more valuable than roentgen examination were grouped as follows: (a) roentgen examination: gastric ulcer? carcinoma; gastroscopy: carcinoma (7 cases); (b) roentgen examination: benign gastric ulcer; gastroscopy: gastric ulcer? carcinoma (5 cases); (c) roentgen examination: doubtful; gastroscopy: carcinoma (1 case); (d) roentgen examination: gastric ulcer; gastroscopy: malignant polyps (1 case); and (e) roentgen examination: gastritis; gastroscopy: carcinoma (1 case). Illustrative cases are cited for each group and briefly presented.

In the 50 cases of proved benign gastric ulcer, both methods were equally correct 16 times and equally doubtful 9 times. In 21 cases the roentgen examination was superior to gastroscopy, and in the remaining 4 cases the opposite was true. As in the cases of carcinoma, the gastroscopic failures were due chiefly to mechanical difficulties. Seven times it was impossible to see the ulcer in the pyloric region, five times, on the lesser curvature of the antrum; two times, high on the lesser curvature; once, near a gastroenterostomy stoma; once because of excessive excretion; and once because of spasm of the body of the stomach. In the other 4 cases in which roentgen examination was superior to gastroscopy, the ulcers were well seen but could not be accurately identified. Six illustrative cases are described in greater detail.

Duodenal ulcers cannot be seen directly through the gastroscope but they are included because of the associated gastritis.

In 8 cases of proved jejunal ulcer (following gastroenterostomy) both methods were equally correct 3 times, equally incorrect twice, and in 3 the roentgen ray was superior to gastroscopy.

Since gastritis is the most common disease of the stomach, and since the roentgenologist cannot differentiate between the different types, gastroscopy here is of great importance. Superficial gastritis as seen gastroscopically corresponds to the acute gastritis

described by the pathologist. Elsewhere, the author, in association with Mallory, studied 51 resected specimens and found agreement in two-thirds of the cases of superficial gastritis, two-thirds of the cases of atrophic gastritis, and three-fourths of the cases of hypertrophic gastritis. In a series of 1,300 cases examined gastroscopically, chronic or hypertrophic gastritis without other gastric or duodenal pathology was found in 117 cases (9 per cent). A roentgen diagnosis of gastritis was mentioned in only one-third of the 117 cases. Certain typical types are briefly discussed and illustrated.

In 7 cases of proved benign tumors the two methods seemed about equal on three occasions; twice the roentgen ray was better, and twice gastroscopy was better.

Of the 5 cases of lymphoma, in 3 the lesion seemed quite typical of carcinoma by both methods of examination, in the fourth case the diagnosis was inconclusive, and only in the fifth case was lymphoma mentioned by either method of examination.

In the 2 cases of sarcoma, a correct diagnosis was made on the basis of histopathological study.

This was also true of carcinoma of the pancreas (in 3 cases) which proved at operation to have invaded the wall of the stomach, although the malignant nature of the lesion was suspected in 2.

In the 4 normal stomachs, the roentgen examination and gastroscopy were equally correct.

The general conclusion is that both the roentgen examination and gastroscopy occupy a very important place in the diagnosis of gastric disease. If the gastroscopist can get a satisfactory view of the lesion his chances of reading a correct diagnosis are greater than those of the roentgenologist. Further technical improvement in gastroscopy is desirable.

T. LEUCUTIA, M.D.

Gilbertson, E. L., and Kirklin, B. R.: A Review of the Literature on Roentgenology of the Gastrointestinal Tract for the Year 1944. *Gastroenterology*, 1946, 6: 112.

This article is a review of the literature on roentgenology of the gastrointestinal tract for the year 1944.

Templeton and Moore studied 29 patients who had cardiospasm and strictures in the esophagus. Examination was made with the patients in the prone position. They stated that three types of muscular action are seen normally in the esophagus: (1) a primary wave, a part of deglutition, forcing the bolus along as it travels down the esophagus; (2) a secondary wave, not initiated by swallowing, which begins in the region of the aortic arch; and (3) a tertiary or localized contraction, which is nonperistaltic. In cardiospasm the primary wave fades out at the suprasternal notch and the main action resembles the localized or tertiary contractions seen in older patients. Bakwin, Galenson, and LeVine made roentgen studies of the esophagus after a meal of opaque material had been given to 32 normal infants ranging in age from 3 weeks to 22 months. They found that

the normal esophagus in the infant is a distensible tube that may be as wide as, or wider than, the vertebral column. Hansson presented 3 cases of varices of the esophagus in children. He suggested a roentgenogram of the esophagus in all cases of unaccountable gastrointestinal hemorrhages in children. Two cases of peptic ulcer of the lower part of the esophagus, and the advantages of roentgenoscopic and roentgenographic study in these cases were described by Lust and Peskin. Adams related his experiences with 28 surgically explored cases of carcinoma of the esophagus from 1937 to 1943. During this time 100 cases were encountered at the Lahey Clinic. In 72 cases the carcinoma was too far advanced at the time of diagnosis to justify exploration. Only 16 lesions, less than half of those explored, were suitable for resection. A good, brief discussion, including the anatomy and nerve supply, and the theories of pathogenesis and differential roentgenological diagnosis of cardiospasm was given by Niehaus. He reported statistics on 40 cases. A brief discussion of diaphragmatic hernias with special reference to parasternal herniations or herniations through the foramen of Morgagni was presented and illustrated with cases by Ritvo and Peterson. They concluded that the occurrence of a rounded mass in the anterior inferior portion of the right lung adjacent to the right border of the heart requires that parasternal hernia be considered the diagnosis until it is disproved by examination after a barium enema and opaque meal. Thirty-eight cases of diaphragmatic lesions were discovered in routine roentgenograms of the chest of 412,149 patients by Kinzer and Cook. They classified only 3 of these as true diaphragmatic hernias. In the 35 other cases the lesions were congenital evenerations of the diaphragm; 3 of the 35 cases were reported in detail.

Hefke stated that a large number of cases of pyloric stenosis in children can be diagnosed on roentgen examination of the stomach. The opening time of the pylorus is of much more value than the emptying time of the stomach. The most important roentgenological sign is the actual demonstration of the narrowed prepyloric canal. Wakefield stated that hypertrophic pyloric stenosis in adults is probably more common than is usually thought. He was of the opinion that it should be considered in the differential diagnosis of any pyloric obstruction. Most of the patients (more than 80 per cent) who have hypertrophic pyloric stenosis are males. He quoted Kirklin's criteria for the roentgenological diagnosis; namely, mushroom configuration of the base of the duodenum and elongation of the pyloric canal. Templeton gave consideration to the normal and pathological roentgenographic appearance of the stomach after various types of anastomoses. He stated that roentgenological examination of the postoperative stomach is difficult and depends largely on good roentgenoscopic technique and familiarity with the different surgical procedures used in the treatment of ulcer and carcinoma. Warren and Meissner stated that chronic gastritis may be a precursor of carcino-

ma, but not all of its types and stages are necessarily precancerous. They examined tissue from 356 stomachs which were removed because of carcinoma or peptic ulcer. According to the authors the histological changes should be divided into the exudative and epithelial; the former have no significance as a precursor of cancer. When epithelial changes become severe, they are similar to premalignant lesions elsewhere in the body. Ude said that the nature of a pathological lesion may be determined more accurately by a skilled roentgenologist than by a surgeon upon visual inspection or palpation of the gross surgical specimen. A detailed report on the incidence of peptic ulcer in various countries, and the age groups in the two sexes in various occupations and in relation to body build was made by Patterson. According to Blum, only 15 proved cases of benign gastric ulcer on the greater curvature have been reported in the literature. He added another case. Palmer and Humphreys showed the factors involved in the actual or apparent resolution of a carcinomatous ulcer in the stomach, which make it simulate a benign ulcer. This apparent resolution is attributed to peptic digestion of the carcinoma and adjacent tissue. Tumors of the cardia of the stomach are best visualized by demonstrating a tumor mass through gas in the cardia. In some cases there is sufficient gas in the stomach for this. Wasch and Epstein described and illustrated the use of a Levine tube to create a large gas bubble. Methods of examination and the roentgenological findings in carcinoma of the cardiac end of the stomach were considered, and a new roentgenological sign consisting of a cardiac pouch was described. This sign had been demonstrated in 5 cases by Elkeles. From the Presbyterian Hospital in New York, St. John, Swenson, and Harvey related an experiment in the early diagnosis of gastric carcinoma. They made rapid roentgenoscopic examinations on 2,232 patients more than 50 years of age who were in the hospital for reasons other than gastrointestinal complaints. In this group of patients they found 3 unsuspected malignant gastric tumors and the diagnosis was confirmed later at surgical exploration. Marshall and Aronoff reported the types of gastric tumors found in 464 patients operated on at the Lahey Clinic in a 5 year period. Benign tumors constituted 2 per cent of the group; 3.2 per cent were sarcomas; and the remainder, 94.8 per cent, were carcinomas. In a brief but good discussion of the roentgenoscopic signs of tumors of the posterior wall of the stomach, Jonas mentioned diversions of the normal path of the initial inflow of barium into the stomach, the appearance of a white barium free circle on palpation, a central black spot in the white circle denoting ulceration or crater, and abrupt interruption of the mucosal folds. Signs of infiltration include loss of flexibility, absence of peristalsis, and deformity or raggedness of the outline of the stomach.

Retroperitoneal perforations of the duodenum were discussed by Jacobs, Culver, and Koenig. The great majority are due to trauma and occur in the

second or third portion. The value of proper roentgenological examination in making the early diagnosis of this otherwise highly fatal perforation was shown. The roentgen findings in 228 cases of mechanical ileus in which the obstruction was situated within the abdominal cavity were presented by Friman-Dahl. Bartels and Harris emphasized the occasional occurrence of intestinal obstruction with negative roentgenological findings and of positive roentgenological findings in cases in which obstruction is not present. Five cases were reported in which a preoperative diagnosis of obstruction was made and the operative findings failed to reveal obstruction. Maissa discussed and illustrated the roentgenological diagnosis of ileitis with special reference to tuberculous ileitis. A review of 26 primary malignant tumors of the small bowel encountered during a period of 16 years was presented by Warren. In his review the second portion of the duodenum and the duodenojejunal junction were the most frequent sites. Two cases of tumor of the small intestine were reported by Smith, Good, and Gray. In discussing the roentgenological aspects of tumor of the small bowel Good stated that roentgenological examination of the ileum and jejunum should be done in cases in which no lesion in the rest of the alimentary tract has been found to explain the bleeding. During a period of 3 years at the Mayo Clinic, 266 potential sources of bleeding were found in the stomach and duodenum to each 1 found in the remainder of the small intestine.

The clinical features, diagnosis, and treatment of carcinoma at the various anatomic sites in the colon were discussed by Beilin, and the diagnosis and treatment of carcinoma and lymphosarcoma of the colon were outlined by Tilton. Wolfer commented in detail on some of the clinical and roentgenological aspects of polyposis, carcinoma, and diverticulitis of the sigmoid and pelvic portions of the colon. After a study of 24 cases Klein said that lymphogranuloma venereum involving the colon has certain definite roentgenological characteristics. These include destruction of the mucosa, rectal stricture, distention of the rectal pouch, and single and multiple perirectal and perisigmoidal sinus and fistulous tracts. The clinical and roentgenological signs of postirradiation stricture of the rectum and sigmoid after treatment for carcinoma of the cervix were well outlined by McIntosh and Hutton. Symptoms seldom are due to recurrent malignancy and should be considered secondary to irradiation until proved otherwise. Anatomic defects may be present without functional impairment. The value of roentgenological examination of the gastrointestinal tract in chronic diarrheas of childhood was expressed by Diamond.

The details of radiographic technique and the principles of roentgenological interpretation of cholecystography were discussed by Sosman. He favored the use of prodiac and stressed the importance of good roentgenograms if an accurate diagnosis is to be made. Huber reviewed the literature regarding the use of cholecystography in jaundiced

patients and found a great divergence of opinion as to its value and safety. He presented cholecystographic findings in 50 cases of jaundice. He concluded that cholecystography in jaundice, while apparently not harmful, is of little value when jaundice is increasing, and can be deferred if jaundice is decreasing. The importance of a plain abdominal roentgenogram in demonstrating stones of the common and cystic ducts was noted by Sahler and Hampton. They stated that stones can be suspected in any case in which calcification is seen in the region of the gall bladder and common duct, whenever there is milk of calcium bile, or whenever the patient is jaundiced. Additional roentgenological studies with opaque media may be necessary before a definite diagnosis can be made. Calthrop reported the oral use of pheniodal suspension in 100 cases of cholecystography and considered it a safe, convenient, economical, and satisfactory means of examining the gall bladder. The use and advantages of priodax in visualization of the gall bladder were reported in a well illustrated article by Dannenberg. The advantages of priodax over preparations previously used also were brought out in other articles by Ochsner, Hefke, Bryan and Pedersen, and Vaughan and Eichwald. Ochsner stated that priodax is reliable, easier to take, produces fewer reactions, leaves little residue in the bowel because it is excreted mainly through the kidneys, and is of such density within the gall bladder that stones will be demonstrated if present. Hefke's reports were based on 600 examinations. Boyden and Rigler noted that previous studies have shown that the gall bladder of women in the last two trimesters of pregnancy empties more slowly than that of nulligravidae women. They found that the rate of emptying of the stomach appeared to have little or no effect on evacuation of the gall bladder and therefore believed that it is not a primary factor in causing the delayed evacuation of the gall bladder in pregnancy. Cholangiography in relation to lithiasis and physiopathology of the biliary tree and some of the difficulties encountered were the subjects considered by Bengolea and his associates.

Poppel and Marshak divided pancreatic lesions into four arbitrary groups in order to study the roentgenological features. In group 1 were lesions of the pancreas which could be seen in the simple roentgenogram; the most usual lesion was calcification. In group 2 were lesions which produced effects on the contiguous structures: of these, carcinoma was the most common. In group 3 were lesions which produced effects on structures not intimately related to the pancreas; for example, peritonitis, as from meconium ileus or acute pancreatitis. In group 4 were lesions which did not produce roentgenological manifestations, such as diabetes mellitus.

The indirect signs of amebic hepatitis in 10 cases were discussed by Munk. Among the signs are elevation of the right side of the diaphragm, restricted or abnormal movement of the diaphragm, secondary pulmonary changes including atelectasis of the right lower lobe, and pleurisy. Thorotrast hepatosple-

graphy was developed in 1929 and consists of roentgen examination of the spleen and liver after the intravenous administration of a stabilized colloidal solution of thorium dioxide. Yater has used this method in several hundreds of cases for 13 years and a follow-up study of 286 patients revealed no harmful effects. Thorotrast is most valuable in the diagnosis of hepatic abscess, but is also of value in the diagnosis of tumors of the liver. The technique of its use and case histories were given by Yater. The colloidal preparation of thorium dioxide, known as thorotrast, was used by McClure and his associates for the demonstration of gross anatomic changes in the liver and spleen. Thorotrast, which is given intravenously, is taken up by the reticulo-endothelial cells, and thus a clearly defined shadow visible by means of the roentgen rays is produced. The authors maintained that no ill effects have been proved to result from the thorium. They first administered it 10 years ago and no untoward symptoms have developed.

The diversity of opinions concerning the value of roentgenology in the diagnosis of appendicitis was reviewed by Gomez. He expressed the belief that roentgen examination is important not only because it rules out or confirms disease in other organs of the gastrointestinal tract, but also because it reveals direct and reflex signs in the appendicular region which can be ascertained by the examination. The value of pneumoperitoneum as a diagnostic procedure was discussed by Maxfield and McIlwain. Reiley expressed the opinion that duodenal regurgitation is most often found in association with, or as a reflex from, disease of the upper part of the renal tract. A plea for closer co-operation between the clinician and roentgenologist was sounded by Lehman. He stated that functional derangements in the gastrointestinal tract cannot and should not be diagnosed by the roentgenologist. Roentgenological diagnosis should be limited to organic conditions.

CHARLES BARON, M.D.

Jansson, G.: Roentgenological Skeletal Changes in Myeloma in Childhood. *Acta radiol., Stockh.*, 1946, 27: 73.

Multiple myeloma is usually considered a disease occurring in older people. The author has been able to find only 8 reported cases in children. To this group he adds the following case.

The patient, a boy 9 years of age, was first seen in the spring of 1942, at which time he complained of pain in the back. Associated with this was recurrent fever, progressive anemia, and an increase in the blood sedimentation rate. He was treated in a war hospital from September to December. During this time, because of large numbers of granular casts, leucocytes, and solitary red cells in the urine, a tentative diagnosis of nephritis was considered. By the middle of December, however, the urine was free of albumin, casts, leucocytes, and red cells. On January 1, 1943 the hemoglobin was 22 per cent, the red blood count was 1,370,000, the white blood count



4,300, with 20 per cent neutrophils, 75 per cent lymphocytes, and 3.5 per cent myelocytes. In spite of repeated blood transfusions the anemia progressed and the patient expired on February 14, 1943.

Röntgen examination of the skeletal system revealed extensive changes. The pelvic bones and the upper ends of both femurs showed multiple, large and small, cystlike, punched out areas of destruction. There were similar areas in the distal ends of the femurs and proximal ends of both tibiae. The epiphyses were also involved, as well as the proximal ends of both humeri and scapulae. There was marked osteoporosis with collapse of all the vertebral bodies. Some of the bodies were represented by thin plates, others had a biconcave configuration. The intervertebral plates were larger than normal. There were no cystlike areas within the vertebral bodies. The skull and ribs were normal in appearance.

The roentgen diagnosis was Schüller-Christian disease, although exophthalmos and diabetes insipidus were not present. Because of the patient's age, metastatic carcinoma was thought to be unlikely. The correct diagnosis was made from the findings at autopsy. The myelomatous process had infiltrated the liver, spleen, and kidneys, and had diffusely involved the vertebral bodies, causing their collapse.

R. B. LEWIS, M.D.

Garland, L. H., and Thomas, S. F.: Spondylolisthesis; Criteria for More Accurate Diagnosis of True Anterior Slip of the Involved Vertebral Segment. *Am. J. Roentg.*, 1946, 55: 275.

Spondylolisthesis has of late acquired increasing importance in connection with the care and disposition of military and industrial personnel claiming disability. The diagnosis of advanced cases is simple, but in the early stages various confusing factors may arise.

The term spondylolisthesis means an anterior displacement of a vertebral body with solution of continuity of its posterior arch (spondylos, a vertebra; olisthesis, to slip). The solution, which nearly always is bilateral, consists of slender fissures in the interarticular portions of the neural arch. It can occur in any segment of the spine, but is most common in the fifth lumbar vertebra. Other confusing types of displacement are: (a) anterior dislocation of a lower lumbar vertebra usually associated with fractures of the articular processes either on a traumatic or pathological basis; (b) elongation of a lower lumbar body (localized platyspondyly), which may be congenital or acquired, and (c) foreshortening of a lower lumbar body (localized brachyspondyly), which may or may not be associated with interarticular defects in the neural arch. If defects are present a spondylolisthesis, Grade I, may erroneously be diagnosed.

One often sees two additional terms used rather loosely: prespondylolisthesis, which is applied to a condition in which there are interarticular defects in the neural arch of a vertebra, but without forward displacement of the body of the vertebra, and reverse

spondylolisthesis, a term which is used for the designation of a situation when the vertebral body lies or appears to lie on a plane dorsal to that of its fellows. Both of these terms must be condemned.

The cause of the defect in the neural arch is unknown. A congenital origin was advanced but anatomists cast some doubt on this. A traumatic etiology either at birth or in infancy, with vascular disturbances of the neural arch, is more probable. The normal stress of the weight of the body, combined with such varying factors as occupational strain, weakening of the muscles and ligaments from age or disease, and softening of some of these structures from pregnancy, then causes in time the forward slipping of the involved vertebral segment.

From the pathological standpoint, true spondylolisthesis is classified as minimal, early, moderate, and advanced. The vast majority of the cases observed by the authors were in the minimal stage. In this stage the posterior one-third of the vertebral segment is retained in more or less normal alignment, and the anterior two-thirds show a forward displacement of 1 or 2 mm. which sometimes increases in the erect position or with heavy weight bearing. There may be associated anomalies, as, for example, cleft in the spinous process, aplastic articular process or processes, etc. In the early and moderate stages the changes are correspondingly more pronounced. In the advanced stage the forward displacement is marked and sometimes associated with downward tilting of the involved vertebral segment. The slipped body may even overlap the mid-sacrum. In addition, there are variable degrees of thinning of the subjacent disc, much new bone formation on the fifth lumbar and first sacral bodies, gross distortion of the neighboring ligaments and soft tissues, and stretching or compression of the segmental spinal nerves.

The diagnosis in the minimal and early stages is a roentgenological problem. It requires the demonstration of (a) unequivocal forward displacement of a vertebral body, in the presence of (b) a defect, or defects, in the neural arch. Correct positioning and the examination in several standardized views is essential. The following criteria may be of additional value: (c) overlapping of the shadows of the transverse process of the involved segment on those of the subjacent one, (d) obscuration of the margins of the involved body, and (e) apparently increased density of the fifth lumbar body, owing to overlapping.

The authors discuss in detail the various roentgen criteria which aid in the recognition of an anterior and posterior margin displacement.

Altogether, they studied roentgenograms of the lumbosacral spine in 170 consecutive cases, and determined the length, shape, and relative position of the body of the fifth lumbar vertebra. The results are tabularly presented, and typical roentgenograms are used for the purpose of illustration. Briefly, it was found that 25 persons (14.7 per cent) had more or less foreshortened last lumbar segments. In 15

of these no defects of the neural arch were present, but the posterior edge of the last lumbar body lay from 1 to 3 mm. ventral to the plane of that of the first sacral segment. In the other 9, arch defects were present, but in only 4 was the anterior margin of the fifth lumbar body ventral to the test line, representing true spondylolisthesis. There were 4 additional cases of true slip with bodies of normal shape and length.

Widmann, B. P.: Results of Roentgen Treatment of Leucemia. *Am. J. Roentg.*, 1940, 35: 377.

Roentgen therapy in chronic leucemia is an excellent palliative measure. The author reports the course and the results of treatment of 110 patients. Of these, 46 were too ill to be treated. A follow-up was not available on 15 patients who were treated with irradiation. A follow-up of the remaining 49 patients revealed that 21 were still alive; 12 patients lived 6 months or less; 17 lived 3 years or more; 7 lived more than 5 years; 2 lived 13 years; 3 lived 18 years; 1 lived 19 years.

The main symptoms were weakness, loss of weight, cough, dyspnea, edema of the extremities, loss of weight, pain, splenic and generalized lymph node enlargement. Biopsies were taken in 21 per cent of the cases. There was practically no difference in the clinical course between the lymphoid and myeloid leucemia. The average duration of life from the time of treatment was 3-3 years in the lymphoid group and 2-7 years in the myeloid group. It is possible that the long life of a few of the patients was due to the benign character of the disease and not to irradiation.

The blood count is a good criterion of the progress of the disease. Treatment was given only when the symptomatology warranted therapy. Some patients have a tolerance for a high white count. The basal metabolic rate is a pre-indicator of the blood picture. An increased basal metabolic rate indicates an early rise in the white blood count; it is not necessarily an indicator of the clinical condition of the patient. Technical factors used in the treatment of patients were variable, ranging from 125 to 200 kilovolts. The spleen, mediastinum, ribs, and enlarged lymph nodes were treated. The long bones were treated only when whole body irradiation was given.

Although the life span in this series of patients may have been only slightly increased, the author is of the opinion that irradiation is an excellent palliative procedure. In more than 50 per cent of the cases treated, the patients were restored to normal efficiency.

Maurice D. Sacas, M.D.

Den Hoed, D.: Carcinoma of the Larynx after Roentgen Irradiation (Kehkopflebs nach Strahlenebehandlung). *Acta radiol.*, Stockholm, 1946, 27: 20.

The author calls attention to 2 cases of carcinoma of the larynx following x-ray irradiation of the neck, which had been reported by Lossen, and adds 2 cases of his own.

The first patient was a man who had been irradiated in 1915 at the age of 16 for tuberculous lymph-

omas. He had probably received about 20,000 r. to the right side of his neck. In 1939, at the age of 40, an ulceration which did not respond to treatment with ointments was seen in the treated skin area. In 1942 a nodular ulcerating tumor involving the left half of the larynx was observed together with a metastasis in the left neck region. After tracheotomy and fractionated doses and a single dose of 1,000 r. delivered to the laryngeal tumor by means of a contact tube through a special tubular guide which was applied under general anesthesia. Complete healing took place. The roentgen ulcer on the other side of the neck improved, although it must have received additional radiation from these procedures.

The second case was that of a 41 year old woman who had received x-ray treatments to both sides of her neck for tuberculous glands 25 years before her visit to the author in 1940. Among other typical irradiation changes, the skin showed an ulceration under the left ear, which was found to be a basal cell carcinoma. It was removed and the defect closed with a skin graft. In 1943 a tumor involving the right arytenoid cartilage and the right aryepiglottic fold was seen and found to be a cornified squamous cell carcinoma. Contact tube treatments were given to the larynx under local anesthesia (12,500 r. in fractionated doses within 4 weeks). Complete healing occurred. The patient was symptom free at the time of the report in 1945.

The author suspects a causal connection between the irradiation treatments to the neck and the appearance of the laryngeal tumor in both cases.

GERHART S. SCHWARTZ, M.D.

## MISCELLANEOUS

Pfahler, G.E.: The Treatment of Hemangioma. *Radiology*, 1946, 46: 159.

Following his experience with 520 cases of hemangioma, the author selected 12 quite different ones, several of them spectacular, to demonstrate the various methods applicable to the treatment of this tumor, and to illustrate the point that the treatment chosen should vary with the point that the treatment details of the treatment, and the age of the lesion, its size and location, and the age of the patient, before, during, and after completion of the treatment, article is accompanied by photographs of the lesion for the port wine type of hemangioma; both roentgen rays and radium have produced atrophy and telangiectasis, and electrodesiccation has given scarring. He believes it best to cover such lesions with a cosmetic. The cavernous and strawberry types, however, have responded satisfactorily in nearly all instances to irradiation, and although experience gamma irradiation has given the most uniformly good cosmetic result, especially when the lesions are relatively superficial, i.e., not over centimeters in depth.

He usually arranges 10 mgm. radium tubes, having 1 mm. platinum filtration, evenly in a plaque the precise size and configuration of the lesion so that it surely reaches the edges thereof, and places it only a short distance (often only 2 mm.) from the surface, timing the exposure so as to give an estimated half-erythema dose at each application. The duration of the application varies of course with the strength of the plaque, the filtration, and the distance. The distance of the radium from the surface should equal approximately the depth of the lesion. The interval between radium treatments is usually from 6 weeks to 3 months, oftener the latter, for it takes at least this long to obtain the major effect of the treatment.

The fact that radium can be applied without pain and retained by adhesive plaster without immobilizing the patient has made it especially desirable in children. Further, since hemangiomas of the cavernous and strawberry types are relatively superficial, radium has permitted rather sharp limitation of the treatment to the lesion.

The author warns of the necessity for walling off the radium applicator from adjacent normal tissues, especially the eyeball, eyelashes, and eyebrows, tooth buds, and epiphyses.

In the deeper variety of hemangioma, after preliminary surface irradiation, and when there remains

a thick fibrous mass, 10 mgm. radium needles are inserted 1 centimeter apart, and left in place 2 hours. In especially deep hemangiomas, and occasionally in large irregular, more superficial ones (to even the dose), x-ray treatment is added.

The author does not use radium for lesions overlying the testicles or ovaries, and recommends electrodesiccation under local anesthesia instead. The latter method has proved useful for small superficial lesions so located that a slight scar was not objectionable, such as small scalp hemangiomas, but is to be avoided in eyelid lesions because of the danger of contracture. Since radium treatments require a number of visits, and a period of one year or more to accomplish satisfactory results, he recommends electrosurgery with wound suture in cases in which the lesion is large, time is important, and a scar is unimportant, provided the lesion is supported by a good layer of cutaneous tissue and is sufficiently movable to allow suturing. The method is particularly desirable for lesions located over one of the larger epiphyses, where irradiation might cause damage. For lesions over the epiphyses of fingers and toes, however, the author has continued to use radium, for lack of a better alternative, and has as yet encountered no evidence of damage to underlying bone.

LILLIAN DONALDSON, M.D.

## MISCELLANEOUS

### CLINICAL ENTITIES—GENERAL PHYSIOLOGICAL CONDITIONS

Milam, D. F.: Plasma Protein Levels in Normal Individuals. *J. Lab. Clin. Med.*, 1946, 31: 285.

Blood protein determinations were performed on the oxalated plasma of 1,561 presumably normal persons by the semi-micro-Kjeldahl method.

The mean total protein level for white persons was 7.19 gm. per cent, and for colored persons 7.44 gm. per cent. The mean albumin was higher among white than among colored individuals—4.65 and 4.45 gm. per cent, respectively. The globulin level was, therefore, higher in the colored group—3.04 and 2.59 gm. per cent. The mean albumin-globulin ratio was 1.80 among white persons, and 1.46 among colored persons. The difference between the races in globulin levels was twice as great as that between the age and sex groups of the same race. SAMUEL KAHN, M.D.

Hegsted, D. M., Tsongas, A. G., Abbott, D. B., and Stare, F. J.: Protein Requirements of Adults. *J. Lab. Clin. Med.*, 1946, 31: 261.

Nitrogen balance studies were made on 26 adults in apparent good health, with a low protein diet devoid of animal protein. Approximately 50 per cent of the protein used was supplied by white bread, 12 per cent by other cereals, 30 per cent by vegetables, and 8 per cent by fruit. Caloric equilibrium was maintained with sugars, starch and fat.

It was found that the nitrogen requirement is more closely related to the surface area (basal caloric expenditure) than to the body weight. The requirement for maintaining the nitrogen balance was approximately 2.9 gm. of nitrogen (18 gm. conventional protein) per square meter of body surface. A man weighing 70 kgs. would thus require between 30 and 40 gm. of protein, according to his height.

On the same diet, with one-third of the protein replaced by meat, the requirement appears to be 2.4 gm. of nitrogen per square meter of body surface (15 gm. conventional protein). Protein requirement is thus about 17 per cent less on this diet than on the all vegetable diet.

Data on digestibility and biological value were determined. The importance of these two measurements for evaluating the nutritional value of a protein is emphasized. High quality proteins are more efficient, but less efficient proteins may serve equally well, provided that enough can be fed to cover the requirements, with consideration of the specific digestibility and the biological value. The biological value of the low protein all vegetable diet used in the studies was increased from 72.5 to 80.4 by replacing one-third of the protein with meat. The digestibility of the two diets was the same.

There was no measurable objective change in the physical condition of any of the individuals through-

out these studies. Some complained of undue postprandial hunger and fatigue on the low protein all vegetable diet; these complaints were not present on high protein diets.

There was no significant change in hemoglobin, hematocrit, or plasma volume. The total protein, plasma albumin, and plasma globulin tended to decrease on the all vegetable diet, when fed at a level low enough to produce a negative nitrogen balance. The replacement of one-third of the protein in this diet with meat resulted in a prompt increase in the globulin fraction.

It is most unlikely that protein deficiency will develop in healthy adults on a diet in which cereals and vegetables supply adequate calories.

SAMUEL KAHN, M.D.

Madden, S. C., and Whipple, G. H.: Amino Acids in the Production of Plasma Protein and Nitrogen Balance. *Am. J. M. Sc.*, 1946, 211: 149.

The use of whole blood, blood plasma, and plasma substitutes is important in emergencies, battle injuries, burns, chronic infections, and protein depletion due to starvation or disease. It has been shown that the body can make plasma proteins and maintain nitrogen balance when the sole source of nitrogen is a protein digest or a mixture of the 10 essential amino acids. We, as yet, know little very about the influence of single amino acids upon the body metabolism, and recent work with methionine and cystine is just beginning.

Studies on the utilization of amino acids given by oral and parenteral routes in dogs and human beings make it appear that the oral route results in superior utilization for plasma protein formation and for nitrogen balance. Mixtures of synthetic amino acids exhibit a surprisingly good utilization, and no toxicity was found in the doses and concentrations used. Intolerance at times manifests itself by nausea and vomiting, but no evidence of serious or persistent injury has ever been observed in animals or man with the material studied. Glutamic acid and aspartic acid may lower the tolerance of amino acid solutions, but glycine seems to improve such tolerance. Subcutaneous injection of solutions of crystalline amino acids in more than 10 per cent concentrations are well tolerated. Mixtures of the 10 essential amino acids plus glycine given parenterally and yielding less than 800 calories per day did not result in nitrogen balance; only if the caloric value exceeded 1,200 was a nitrogen balance obtained.

Synthetic amino acids are preferable to protein digests because they can be mixed in different concentrations with the aim of combining them for specific purposes; for example, in order to enhance the production of gamma-globulin, a mixture of amino acids contained in gamma-globulin might be used.

Amino acid mixtures are better tolerated than protein digests on parenteral administration, and are more palatable orally, but the use of the former pure amino acids. A mixture of the so-called 10 essential amino acids in suitable amounts can produce a nitrogen balance if given by mouth, by vein, subcutaneously, or intraperitoneally. The 10 essential amino acids are: threonine, valine, leucine, isoleucine, lysine, tryptophan, phenylalanine, methionine, histidine, and arginine; glycine is usually added. These amino acids are well tolerated by patients suffering from chronic infection, gastrointestinal disturbance, partial obstruction, or cancer cachexia.

ARTHUR J. LESSER, M.D.

Adcock, J. D., and Hettig, R. A.: Absorption, Distribution, and Excretion of Streptomycin. *Arch. Int. M.*, 1946, 77: 179.

Data are presented regarding the absorption, distribution, and excretion of streptomycin administered by various routes.

Streptomycin was not absorbed to any appreciable extent when given orally or by inhalation. Following parenteral administration it was possible to demonstrate the material in the serum in amounts roughly proportional to the dose. Streptomycin appeared in significant concentrations in the spinal fluid of 3 subjects with meningitis and in the pleural fluid of 2 subjects with pleural effusions. In 2 subjects streptomycin was demonstrated in the bile.

A study on the distribution of streptomycin in various organs obtained postmortem showed that it was present in the kidney in high concentration. Smaller amounts were found in the lung and in the heart muscle, while both the brain and the liver contained virtually none.

From 41 to 86 per cent (mean 65 per cent) of the dose was excreted in the urine within 12 hours of the parenteral administrations of streptomycin. Plasma clearance values ranged from 38 to 67 c.c. of plasma cleared of streptomycin per minute.

WALTER H. NADLER, M.D.

De Lorimier, A. A., Minear, W. L., and Boyd, H. B.: Reflex Hyperemic Deossifications Regional to the Joints of the Extremities. *Radiology*, 1946, 46: 227.

There are four types of decalcification due to intravascular hyperemia:

1. A discrete mottling, especially found in the tarsal and in the carpal bones.
2. Deossifications in the ends of the bones. The rarefactions were made distinct by the appearance of metaphyseal bands.
3. Deossifications beneath the subchondral cortices. This pattern was found in the peripheries of the tarsal and carpal bones.
4. A combination of two or all three of the previously mentioned phases.

The author reviewed 239 cases. All of the cases of trauma, infection, and neoplasm showed one of

the patterns of deossification mentioned. No relation could be established between the etiology and the pattern of deossification. Deossifications due to disuse and generalized deossification due to nutritional deficiencies or endocrine changes were not reviewed in this series. The theory is advanced that the pattern of deossification is related to the vascular supply of the bone and its anastomoses rather than to the cause of the deossification.

GEORGE I. REISS, M.D.

Keresztesy, J. G., Laszlo, D., and Leuchtenberger, C.: Neutralization of the Inhibition of Tumor Growth. *Cancer Res.*, 1946, 6: 128.

The antagonism between the compounds promoting and inhibiting growth has received increasing attention in the past few years.

Investigation by a method involving the growth of transplanted tumors in mice has shown that various substances, such as inositol, lactobacillus casei factor, and xanthopterin, are effective in inhibiting the growth of tumors. However, among the substances and extracts tested, none was found that stimulated tumor growth. It therefore appears that the transplants were probably growing at a normal rate. A method was then devised to demonstrate the possible growth-stimulating properties of various substances by measuring their interference with inhibitors of tumor growth. This was accomplished by repressing the growth rate of a transplant by injecting mice intravenously with a suitable dose of a proved inhibitor and, at the same time, with a suitable dose of the substance or extract to be tested for antagonistic activity, the amount of inhibitor neutralized being a measure of the degree of interference.

By adopting this method the authors were able to demonstrate that the action of inhibitors can be effectively neutralized by both structurally related and unrelated substances.

Neutralization by approximately equal amounts of inhibitor and antagonist was observed with regard to the inositol and p-amino-benzoic acid, inositol and pyridoxine, and d-desthiobiotin and d-biotin experiments. Thiamin, niacinamide, o- and m-aminobenzoic acid, and leucopterin were slightly active, if at all, in counteracting the inhibition caused by inositol. Interference could be detected when larger doses of some of these substances were given.

While both d-desthiobiotin and an avidin concentrate were effective inhibitors of tumor growth, neutralization occurred when these two materials were tested for antagonism. Impurities in the avidin concentrate may be responsible for this interference.

Although in the studies reported here definite interference has been shown to occur between the inhibitors of tumor growth and their antagonists, chemically related or unrelated, it is impossible at this time to state whether these results have any bearing on the chemotherapy of malignant tumors.

Further investigations with various rapidly growing tissues, malignant and nonmalignant, should be carried out. As the substances tested to demonstrate this phenomenon of interference or neutralization were physiologically active, further studies by the authors are under way with simpler or nonphysiological compounds.

JOSEPH K. NARAT, M.D.

Elsen, M. J.: Betel Chewing among Natives of the Southwest Pacific Islands. Lack of Carcinogenic Action. *Cancer Res.*, 1946, 6: 139.

In general discussions on the relationship of natural compounds or agents to the development of neoplasia, it is frequently suggested that betel chewing is a factor in the etiology of oral cancers throughout those portions of the world where betel mixtures are in use, and to some the habit would assume an importance comparable with roentgen or solar radiation, or tar, in the production of tumors of the skin. However, a specific incriminating factor or substance in the materials employed by betel chewers has not been described, neither is there unanimity of opinion regarding the activity of the betel mixture.

According to the experience of the author and Australian workers, betel chewing in the natives of New Guinea, New Britain, New Ireland, and the adjacent smaller islands does not appear to elicit cancer of the mouth.

JOSEPH K. NARAT, M.D.

Morgan, L. O.: Histological Changes in the Central Vegetative Centers of the Hypothalamus in Carcinoma as an Indication of Vegetative Functional Disturbances. *Cancer Res.*, 1946, 6: 142.

The anterior hypothalamus exerts its influence chiefly upon the parasympathetic nervous system and the islands of Langerhans and the posterior hypothalamus chiefly on the sympathetic nervous system and the thyroid and suprarenal glands, while the hypophysis is under the influence of both regions. It is apparent, then, that the hypothalamus utilizes to a large extent the autonomic and endocrine systems in achieving its broad purpose of co-ordinating the vegetative functions in the interest of the total organism.

Thus it seems likely that the nuclei of the hypothalamus, and, perhaps, other closely associated centers outside the anatomical limits of the hypothalamus, are normally in a state of physiological balance. If this be true, then disease, injury, or dysfunction involving one or more of the nuclei would probably tend to throw the entire mechanism out of balance, so that the effects would be more far reaching than might be expected were the nuclei concerned with a single specific function.

It is obvious that hypothalamic dysfunction will exist whenever disease or injury attacks the region directly. It is also possible that disease, injury, or dysfunction in any part of the body, that tends to throw vegetative functions out of balance or to

threaten the welfare of the total organism, may eventually involve the hypothalamus because the central mechanism will be called upon to attempt a restoration of normal function.

Because of these possibilities the striking histological abnormalities that occur in the hypothalamus of the cancer patient may be of considerable significance. Therefore a histological study of 5 nuclei of the hypothalamus in 19 patients with proved carcinoma was made by the author.

Extensive chromatolysis and cell destruction indicated that all these cell groups were involved by carcinoma. The pattern of these changes showed a wide range of variation. A congenital overdevelopment of some of the nuclei was indicated, but the cell destruction that occurs in carcinoma made it impossible to evaluate this factor properly.

The cell changes in the hypothalamus suggest a widespread but variable instability or irregularity of the vegetative functions in the patient with carcinoma. This is in keeping with the findings of numerous investigators who have made functional studies in animals or in human patients with cancer.

JOSEPH K. NARAT, M.D.

#### GENERAL BACTERIAL, PROTOZOAN, AND PARASITIC INFECTIONS

Friedman, L. L., and Signorelli, J. J.: Blastomycosis; A Brief Review of the Literature and a Report of a Case Involving the Meninges. *Ann. Int. M.*, 1946, 24: 385.

Although blastomycosis, known by 19 different names, is a rather uncommon disease, it is, nevertheless, a very important clinical entity when it does occur because the systemic variety usually terminates fatally. Both systemic and cutaneous forms of the infection can successfully mimic many other diseases frequently encountered. In the skin it is characterized by single or multiple pyogenic granulomatous verrucoid lesions, and in the internal organs by single or multiple granulomatous lesions. Although the failure to appreciate the systemic nature of this disease has been largely overcome, knowledge and real understanding of the clinical entity are still very meager and await further clinical and laboratory research.

The largest number of cases are reported as occurring in Illinois and Louisiana, but cases are also reported in Canada, Australia, England, and South American countries. Agricultural workers, common laborers, and people who live or work in damp unhygienic and wooded places contract the disease. Males are affected eight times more often than females. Any age group or race may be affected. The disease is reported most frequently in the third, fourth, and fifth decades. Infection seems to occur through traumatized skin or pre-existing lesions, but may enter by way of the respiratory tract.

The fungus grows on artificial media, producing budding organisms and mycelia without lateral conidia. In a 20 per cent hydroxide solution prepa-

ration it is identified as a doubly refractile ovoid or round body with granular cytoplasm, from 7 to 20  $\mu$  in size. It can often be isolated from purulent drainage, blood, urine, sputum, or stools. Despite dermatological lesions, the fungus must be identified to establish a diagnosis. Complement fixation is not always specific or reliable. It is estimated that from 40 to 50 per cent of all cases of blastomycosis have systemic involvement. The tissues most frequently involved are the unprotected areas of the skin, the subcutaneous tissues, the lungs, and the bones and joints, but any organ may be involved.

Many diseases must be considered in the differential diagnosis: other mycoses, i.e., actinomycosis, coccidioidomycosis, chromoblastomycosis, tinia barbae; pneumonias, tuberculosis, tularemia, syphilis, anthrax, bromoderma, bacterial osteomyelitis, and epidermal carcinomas.

The prognosis of the cutaneous type of blastomycosis is good, as far as life expectancy is concerned, but the disease is generally resistant to treatment. No consistently effective and dependable therapeutic measures are known.

The case report is concerned with a 42 year old colored male laborer, admitted in a comatose condition which was diagnosed as rupial syphilis. The illness began 2½ months prior to admission and progressed rapidly from a nondescript prodrome to purulent cutaneous facial lesions, and systemic involvement of the lungs and meninges. A biopsy of the facial lesion was diagnostic. Death occurred 6 days following admission. JAY P. BARTLETT, M.D.

### DUCTLESS GLANDS

Fell, M. L., and Dorfman, R. I.: The Influence of Urinary Cortinlike Material on the Sodium and Potassium Metabolism. *Endocrinology*, 1945, 37: 437.

It has been demonstrated that urinary extract contains material with biological activities similar to those of the steroid hormones of the adrenal cortex. The known effects on adrenalectomized rats are:

1. Increased resistance to low environmental temperatures
2. Maintenance of life
3. Increase of liver glycogen deposition in the fasting animal
4. Prolongation of average work performed by the gastrocnemius muscle
5. Prevention of water intoxication.

The present report is concerned with the influence of urinary cortinlike material on the sodium and potassium metabolism of normal and of adrenalectomized rats.

The studies indicate that the alkaline insoluble urinary extract of normal man caused an increase, rather than a decrease, of sodium excretion in normal rats. Similar results were obtained with the adrenocortical extracts, but desoxycorticosterone acetate caused a significant retention of sodium.

Urinary extracts of normal man (both alkaline insoluble, and soluble ketonic fractions) protected adrenalectomized rats against intoxication, which was similar to the effects exhibited by adrenocortical extracts and desoxycorticosterone.

ANNIE J. LESSER, M.D.

Reiss, M. J. E. F., and Golla, Y. M. L.: The Peripheral Inhibitory Influence of Large Doses of Testosterone on Epiphyseal Cartilage Growth. *Endocrinology*, 1945, 38: 65.

The present investigation was suggested by the clinical experiences with hormonal therapy of acromegaly carried out in the last 5 years, and reported by Hutton and Reiss in 1942.

Several results of this treatment could not be explained, notably the very quick reaction which several patients exhibited after the onset of treatment with estrone and testosterone. Particularly noticeable in this connection was a patient who developed acute acromegaly after male climacteric changes had begun. His predominant pathological symptoms were—apart from the usual acromegalic symptoms—a very marked growth of the costal cartilages (the patient could not close his coat), and the growth of the thyroid cartilage, which caused almost complete aphonia. After the daily injections of 50 mgm. testosterone propionate for 10 days, the patient's speech was almost completely normal, and the cartilages overgrowth of the ribs not only stopped but regressed sufficiently to enable the patient to again button his coat. Such rapid regression could not possibly be explained by the inhibition of the increased production of growth hormone in the pituitary gland only.

In an attempt to solve this problem, hypophysectomized animals were used, with a view to determining whether the growth response to the injection of growth hormone could be influenced by sex hormones.

Some light may be thrown on the growth hormone correlation by consideration of the effect of certain endocrinological disturbances on body growth, such as the eunuchoid gigantism after prepubertal castration; the cessation of linear bone growth after sexual maturity is reached, when considerable amounts of sex hormones are circulating in the body fluids; and the increased linear growth during puberty, when only small amounts of sex hormones start to enter the body fluids. Other relevant facts are the growth of cartilage that may occur after the climacteric, sometimes even producing acromegalic changes, together with the observation that the growth of male dwarfs can be increased considerably by small doses of testosterone.

The influence of sex hormones on the pituitary gland has been shown in many experiments. The present investigation, however, supports the view that the sex hormones may also directly influence the growth of the bone in the periphery. The experiments described prove an inhibitory action of large doses on the bone growth. A stimulating action, in

sense, as claimed by Simpson *et al.* in 1944 for comparatively small doses, cannot be excluded.

The daily injection of 4 mgm. of testosterone propionate inhibits considerably the cartilaginous growth produced by the growth hormone on hypophysectomized rats. The results suggest an inhibition of the peripheral growth by large doses of sex hormone. The bearing of these results on explanations of certain physiologic and pathophysiologic growth phenomena is discussed.

JOHN E. KIRKPATRICK, M.D.

**Dorfman, R. I., Shipley, R. A., Schiller, S., and Horwitz, B. N.: Studies on the "Cold Test" As a Method for the Assay of Adrenocortical Steroids. *Endocrinology*, 1946, 38: 165.**

The adrenalectomized mouse will respond to cortical extract and to desoxycorticosterone acetate when exposed to low environmental temperatures. From rather brief experiments it appears, however, that the mouse is not well adapted for assay purposes. The rat appears to be a more suitable animal in the cold test for the bioassay of urinary cortin. The cold test is simple, rapid, and potentially very sensitive. Its usefulness is marred by an erratic variation in sensitivity of animals from group to group. The cause of this behavior has not been determined. Rough estimates of urinary cortin may be made if one dose of standard is run simultaneously with several unknowns administered at two or more different dose levels. The accurate assay of urinary cortin by the method requires large numbers of animals and quantities of pure hormone which make it impractical for extended routine use. Sufficient data were obtained to show that a pooled sample of normal male urine contained the equivalent of 0.6 mgm. of 11-dehydrocorticosterone per liter.

**Houssay, B. A.: The Effects of Suprarenal Insufficiency on Pregnancy and the Offspring (Acción de la insuficiencia suprarenal durante la preñez, sobre la madre y el hijo). *Rev. As. med. argent.*, 1946, 60: 83.**

Experiments were conducted by the author with the main purpose of determining the effect of suprarenalectomy of the adult rat on the suprarenal glands of the fetus. Also other observations were made.

When pregnancy was present both suprarenal glands were removed. Some of the rats received no salt whatsoever, while others were fed 1 per cent sodium chloride solution *ad libitum* in addition to a stated diet.

Forty-four rats were observed and divided into a number of groups for different types of studies. The white rats used always possessed microscopic accessory glands which were not visible to the naked eye but became quite large after suprarenalectomy.

During the first period following the operation there was glandular insufficiency, although generally it was not fatal—the symptoms became attenuated and disappeared. Later on, symptoms of hyperfunction of the accessory glands were noted. Exces-

sive atrophy of the thymus and elevation of the blood pressure were among these symptoms.

Ten of 19 pregnant rats not receiving sodium chloride died, whereas the majority of the rats provided with 1 per cent saline solution survived. Second and third pregnancies after the operation were withstood much better, whether the rats had or had not been given sodium chloride because the accessory glands had become hypertrophied. These accessory glands were seen in 66 per cent of the autopsies done within 3 months.

The number of offspring was normal but the offspring were born with a weight which was significantly subnormal. Their mortality was quite marked when the adrenalectomy was recent and its principal cause was diminution of lactation in the mother. When the operation was not recent the litter would live because the milk secretion increased.

The average weight of the suprarenal glands in the offspring of the adrenalectomized rats was increased. This could be attributed to more production of adrenotropin in the maternal pituitary gland or to stimulation of the fetal pituitary gland, or of the suprarenal glands. Although there was an increase in the weight of the glands in the average of all the groups the difference from the control group was not statistically significant; however, if the weight of the glands was calculated on the basis of the body weight the difference was a significant one.

When adrenotropin was injected into the mother her suprarenal glands hypertrophied, but those of the fetus in utero did not. This may have been due to the fact that adrenotropin does not pass through the placenta or that the suprarenal glands of the fetus are not very sensitive.

Desoxycorticosterone injected into pregnant rats prolonged gestation with subsequent excessive growth of the fetuses and difficulty in parturition. The adrenal glands of the offspring were not atrophied.

F. F. REMY, M.D.

## SURGICAL PATHOLOGY AND DIAGNOSIS

**Young, J. S., Cruickshank, A. H., and Martin, W. J.: An Experimental Study of the Healing of Wounds, with Special Reference to the Action of Heart Extract Powder (Doljanski). *J. Path. Bact.*, Lond., 1946, 58: 63.**

Four essential principles have been adduced by Doljanski and his colleagues to explain the alleged remarkable efficacy of heart extract powder in the healing of normal wounds in rats, as well as of indolent wounds in man.

1. "Extracts of certain adult organs—heart, smooth muscle, and brain—activate the growth of fibroblast colonies in vitro to a greater extent than embryonic extract of the same concentration."

2. Substances which promote the growth of fibroblasts in vitro also promote the growth of fibroblasts and other cells in vivo, as in a healing wound.

3. Heart extract powder is anaphylactogenic in man.



4. Heart extract powder possibly functions as a "wound hormone," i.e., its effect on wound healing is not local, but of a general nature.

The progress of healing in 462 experimental wounds in rabbits and guinea pigs was followed by the authors. Heart extract powder (adult sheep heart) and embryo extract powder (whole sheep embryo) applied directly to the surface of healthy wounds were found to retard the healing process.

There is no direct correlation between growth promoting activity *in vitro* and *in vivo* in so far as the healing of healthy wounds can be accepted as a criterion. Heart extract powder exercises no general or constitutional effect on the rate of healing of healthy wounds; it was not found to be anaphylactogenic in the experiments done; and it does not influence either the onset or the progress of infection.

Applied directly to the surface of a wound, heart extract powder evokes a nonspecific foreign-body giant-cell reaction, similar to that evoked by two azo dyes—Scharlach R and Sudan III—which were used as stimulants to the healing of indolent wounds.

SAMUEL KAEN, M.D.

#### EXPERIMENTAL SURGERY

Blalock, A.: The Effects of an Artificial Ductus Arteriosus on Experimental Cyanosis and Anoxemia. *Arch. Surg.*, 1946, 52: 247.

Studies were performed on dogs in an effort to determine whether the creation of an artificial duc-

tus arteriosus would be helpful in the treatment of pulmonary stenosis or atresia in patients. Attempts to produce the desired degree of pulmonary stenosis in dogs which would simulate conditions in the human being were unsuccessful.

The author made the observation that the removal of lobes of one or both lungs and the anastomosis of the severed proximal ends of the pulmonary artery and vein were the most satisfactory procedures to reproduce conditions of oxygen unsaturation, simulating those which were found in patients with pulmonary stenosis.

Six animals withstood the operative procedures necessary to create arterial oxygen unsaturation and accomplish a successful simulation of ductus arteriosus. In 2 of the animals, only a slight increase in arterial oxygen saturation occurred following the making of an artificial ductus, but in the 4 others there was a significant elevation of arterial oxygen saturation. This increase was due to the passage of a greater quantity of blood which was not fully oxygenated through the pulmonary capillaries.

Although the experimentally produced condition was different from that seen in patients with the tetralogy of Fallot, these studies strengthened the impression that an increase in pulmonary blood flow by the creation of an artificial ductus arteriosus is beneficial in situations of diminished pulmonary blood flow and improper oxygenation as seen in patients with pulmonary stenosis or atresia.

DAVID H. LYNN, M.D.

# SURGERY

## GYNECOLOGY AND OBSTETRICS

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### SUBTOTAL ESOPHAGECTOMY WITH HIGH INTRA- THORACIC ESOPHAGOGASTRIC ANASTOMOSIS IN THE TREATMENT OF EXTENSIVE CICATRI- CIAL OBLITERATION OF THE ESOPHAGUS

RICHARD H. SWEET, M.D., F.A.C.S., Boston, Massachusetts

THE majority of patients who have suffered extensive chemical burns of the esophagus have usually been dependent upon repeated dilatations by bouginage or ultimately upon gastrostomy feeding to overcome the obstruction which inevitably follows healing by cicatrization. The inconvenience and suffering which attend the application of these methods make these unfortunate patients eager for any more satisfactory substitute. One method of solving the problem in the intractable case has been the construction of an external subcutaneous artificial esophagus by one of the various plastic procedures. The recent wave of interest in this type of operation is partly the result of the work of Yudin, who reported 80 cases of cicatricial stricture of the esophagus treated by what he refers to as the "Roux-Herzen" type of esophagoplasty, performed usually in several stages, involving the temporary utilization of a gastrostomy. In Yudin's hands the results appear to have been satisfactory from the standpoint of low operative mortality and ultimate function.

There can be no doubt, however, that this is a formidable procedure. Furthermore, the patient is left with a distinctly abnormal relation of the parts of the upper gastrointestinal tract. The jejunum is attached, usually by a

lateral anastomosis, to the cervical portion of the esophagus, often a rather long distance above the highest level of stricture. The stomach is completely by-passed and becomes therefore nothing more than a secretory appendage of the alimentary canal, emptying by way of the duodenum and proximal end of jejunum into the lower portion of the jejunal segment which has been used for the esophagojejunal anastomosis. Although this arrangement is undoubtedly compatible with the maintenance of a normal state of nutrition, it would seem to be desirable to avoid it if possible.

Experience gained in the resection of carcinoma located in the mid-thoracic region has demonstrated that the stomach can be mobilized to such an extent that a very high intra-thoracic esophagogastric anastomosis can be performed (1, 2). By applying this principle to cases in which the growth lay at higher and higher levels in the esophagus, it has finally been established that a safe and functionally satisfactory anastomosis can be performed at the highest level within the thorax, actually behind the jugular notch of the sternum (Fig. 1). The application of this knowledge in the treatment of cicatricial obliteration of the esophagus is the subject of this preliminary report.

## TECHNICAL CONSIDERATIONS

1. *Necessity for esophagectomy.* In order to obtain the complete mobilization of the stomach required to bring its fundus to the apex of the thorax where the anastomosis is to be performed, it is necessary to sever the stomach from the esophagus at the level of the cardia. It then becomes necessary to remove the esophagus, unless the theoretical possibility of reimplanting the distal end of the esophagus at a lower level in the stomach is entertained. A further reason for removing the esophagus is that an end-to-side anastomosis between the esophagus and the fundus of the stomach is easier to perform and better functionally than a side-to-side anastomosis between these two organs at that level in the chest.

2. *Preservation of blood supply.* (A) The preservation of an adequate blood supply to the level of anastomosis is easily accomplished in the esophagus provided that the level of division is high enough to reach the esophageal branch of the inferior thyroid artery. Division of the esophagus at a high level is of such importance that one should never be tempted to cut it at a lower point even if considerable length is available. The danger of sloughing of the end is too great.

(B) The maintenance of blood supply on the gastric side is dependent upon the integrity of the anastomotic intercommunicating vessels within the wall of the stomach itself. In order to free the stomach so as to relocate it with the fundus in the apex of the thorax, all the attachments excepting those in the region of the pylorus and the pyloric portion of the antrum must be divided. This involves the division of the left gastric artery, the vasa brevia, and the left gastroepiploic artery as well as the smaller anastomotic communications near the cardia from the inferior phrenic, suprarenal, and pericardiophrenic vessels, and the majority of the vessels in the gastrocolic ligament. In order to preserve the arcade of vessels on the lesser curvature side, the left gastric artery must be divided close to its origin from the celiac axis in order to maintain the communication between its ascending and descending branches. In freeing the stomach from its attachments by the gastrolial and gastrocolic ligaments to the spleen and colon,

care must be exerted to avoid injury to the anastomotic communications of the gastroepiploic vessels.

After the extensive mobilization of the stomach has been completed, the only source of blood supply which remains is that which comes by way of the right gastric and right gastroepiploic arteries. The distribution of blood to the fundus, where the anastomosis is to be, depends upon the integrity of the arcades along the curvatures; but the intramural communicating branches of these vessels are of equal importance. It is necessary, therefore, in handling the stomach during the course of the operation, to exert every effort to avoid trauma to its wall and to the vessels within it. Forceps and clamps should not be applied, and great care must be exerted to avoid tearing a vessel which might produce a hematoma in the gastric wall.

3. *Avoidance of stricture at the site of anastomosis.* A circular opening in the stomach wall is made so as to avoid the angles at each end of a linear incision. Of greater importance is the necessity for obtaining prompt and accurate healing of the layers of the anastomosis, especially the mucosa. All unnecessary trauma to these edges must be avoided. To accomplish this I strongly advise against (a) the use of crushing clamps on either side of the anastomosis, (b) the use of the cautery or a chemical caustic, such as carbolic acid, in cutting across the esophagus or stomach, and (c) the use of continuous sutures which of necessity tend to constrict the edges and produce necrosis of the tissue which they embrace.

4. *Details of dissection.* The amount of dissection required in performing an esophagectomy in a case of cicatricial stenosis is much less than is necessary in cases of carcinoma. In the former, nothing more than the removal of the esophagus from just above the upper limit of the lesion to the cardia is needed. In the latter, provision must be made for division of the esophagus at the greatest possible distance above the upper limits of the growth. In the stricture cases, furthermore, the lymph nodes can be ignored, whereas in the carcinoma group all the nodes which can be reached should be removed, particularly those around the lower thoracic portion of the

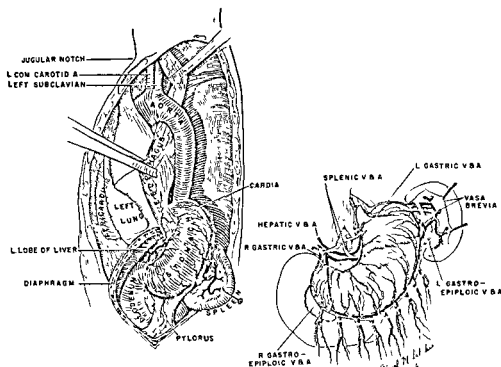


Fig. 1. Diagram to show the amount of dissection necessary in order to remove the entire thoracic portion of the esophagus and to free the stomach sufficiently to perform a high intrathoracic esophagogastric anastomosis at the apex of the chest. View from the left side (Case 3). Inset shows the principal blood vessels of the stomach which must be divided during the process of freeing the stomach: these are the majority of the omental branches of the gastroepiploics, the left gastroepiploic, the vasa brevia, and the left gastric vessels. After division of the cardia, where a few descending branches of the lower esophageal vessels are to be severed, the only blood supply which remains comes by way of the right gastric and right gastroepiploic arteries.

esophagus and the two important groups of nodes which are found below the diaphragm (1).

In spite of these facts, the actual mobilization of the esophagus in a case of cicatricial stricture resulting from a chemical burn is always more difficult than it is in the average case of carcinoma. In the latter, the only difficulty which is encountered occurs at the site of the growth. In the stricture cases, however, the damaged segment is always densely adherent, making it difficult or impossible to find good planes of cleavage for the purpose of dissection. This appears to be the result of an extensive periesophagitis resulting from the burn. It is difficult also, probably as a result of the characteristics of the injury, to discover the exact upper limit of the scarred portion in the esophagus itself, so that after cutting into abnormal tissues at first it is sometimes necessary to choose a higher level for the site of division.

#### DESCRIPTION OF THE OPERATION

The operative procedure which has been used in the treatment of these cases is essentially the same as that which has been applied in the management of cases of carcinoma of the midportion of the thoracic esophagus (1, 2, 3). A brief outline follows:

1. Intratracheal ether oxygen anesthesia is used.
2. The patient is placed on his right side; the left arm is held forward with the hand in front of the face.
3. Intravenous infusion of saline and transfusions of whole blood are given through a hand or forearm vein.
4. The incision is made over the eighth rib on the left side with its posterior portion curved upward between the scapula and the spine. The eighth rib is resected. If the stricture begins at a high level (as in Case 3), it is necessary to divide one or more ribs posteriorly, the number depending partly on the upper

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level of the lesion and partly on the configuration of the patient's chest, whether long or short, and the slope of the ribs.

5. The wound edges are protected with pads of gauze and a rib spreader is inserted. The lung is retracted.

6. The esophagus is then dissected free below the aortic arch. If the stricture extends above the arch, the upper thoracic portion of the esophagus is then freed through an incision in the mediastinal pleura posterior to the thoracic portion of the left common carotid artery. By working both from above and below, the portion behind the aortic arch can be freed from its attachments and the entire thoracic portion of the esophagus is then available for resection. During the performance of this dissection, the small branches from the aortic arch and the bronchial arteries and the usual esophageal branches from the descending portion of the aorta must be severed and tied. The thoracic duct may be encountered as it crosses the esophagus just above the aortic arch. If it is injured, it must be tied so as to avoid the development of a chylothous hydrothorax. (This had to be done in Case 3.)

7. The next step is the mobilization of the stomach (Fig. 1). To accomplish this, the diaphragm must be incised from close to its costal insertion laterally through the hiatus. The phrenic nerve is crushed to maintain the mobility of the diaphragm. The upper two-thirds or more of the stomach are freed by dividing the gastrocolic ligament with its numerous vessels (branches of the gastropiploics), the gastrolenal ligament containing the left gastropiploic vessels and the vasa brevia, and the gastrohepatic ligament with the left gastric vessels. The left gastric artery is cut close to its origin from the celiac axis so as to preserve the integrity of the anastomosis between its ascending and descending branches. The retroperitoneal attachments of the stomach to the diaphragm near the cardia are divided. Here one encounters several small vessels which must be tied (branches of the phrenic, pericardiphrenic, and the subprerenal arteries).

If the patient has a pre-existing gastrostomy, it can be taken down from within the

abdomen and the opening in the anterior gastric wall closed with two layers of suture (Case 3).

The stomach is cut across between clamps just distal to the cardia. The proximal end is covered by tying a rubber glove or piece of rubber dam over it. The distal portion is inverted by means of two layers of fine catgut reinforced with interrupted silk sutures.

8. The esophagus can now be drawn up from behind the aortic arch and turned outward in a position convenient for the performance of the anastomosis (Fig. 2). At a high level on the fundus of the stomach a circular incision of appropriate size is made through the serosal and muscular coats. The small vessels encountered are ligated with fine silk so as to diminish as much as possible the amount of bleeding during the completion of the anastomosis. This portion of the fundus of the stomach is then placed in the apex of the chest and a three layer anastomosis is performed between the end of the esophagus where it is cut across above the level of the stricture, and the circular opening in the stomach wall which results from excising the portion previously outlined by incision through the serosa and muscularis. Interrupted sutures of fine silk are used. The sutures of the mucosal layer are placed in such a way that the knots lie within the lumen when tied.

9. The anastomosis having been completed, the stomach should be fastened within the chest by means of a series of fine silk suture (Fig. 3).

10. The edges of the diaphragm are fastened to the antral portion of the stomach where it passes through and the remainder of the ruptured silk sutures.

11. A catheter for closed suction drainage is brought out through a small incision in a lower interspace posteriorly.

12. Closure of the chest is effected by careful anatomical approximation of the several layers using interrupted silk sutures. The lung should be fully expanded first.

## POSTOPERATIVE MANAGEMENT

The handling of these cases after operation differs in no respect from that used in the

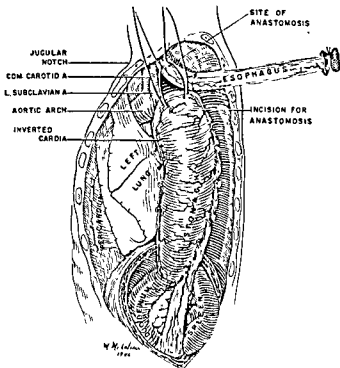


Fig. 2. Diagram to show the start of the anastomosis (as in Case 3). The esophagus has been dissected completely from the mediastinum and pulled up from behind the aortic arch. A circular incision is shown high on the anterior aspect of the fundus; a circular piece of gastric wall is to be removed at that point for the end-to-side esophagogastric anastomosis. The site of transection of the esophagus for the anastomosis is indicated. Note that the duodenum has been drawn to the left and upward by the displacement of the stomach into the chest; the pylorus then comes to lie just below the diaphragm.

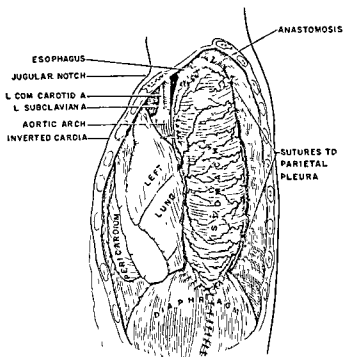


Fig. 3. Diagram to show the anatomical relations of the viscera after the completion of the anastomosis (as in Case 3). The anastomosis lies opposite the jugular notch. The stomach is in front of and somewhat lateral to the aortic arch. It lies behind the hilum of the left lung and against the vertebral column and descending aorta. The diaphragm has been sutured around the stomach just proximal to the pylorus. The remainder of the diaphragmatic incision has been closed. The stomach has been fixed in the chest by means of interrupted sutures of fine silk to the parietal pleura.

carcinoma group. Patients who have strictures from chemical burns are more likely, however, to be much younger than those who suffer from carcinoma and their recovery is therefore somewhat more prompt and less complicated.

#### REPORTS OF CASES

Three patients who had suffered cicatricial obliteration of a large portion of the esophagus as a result of chemical burns were treated by radical esophagectomy. In 2 of these the upper limit of the lesion was low enough to make it possible to perform the anastomosis a short distance below the arch of the aorta. In the third, the proximal extent of the obstructed area was so high that the anastomosis when completed lay behind the level of the jugular notch. In this case a subtotal esophagectomy was performed. That such a high level of intrathoracic esophagogastric anastomosis is

possible will be appreciated by considering the fact that the apex of the thoracic cavity rises several centimeters above the level of the first rib. Thus a high anastomosis, which on first thought might appear to be in the neck, is actually within the thorax at its highest portion.

CASE 1. F. J., MGH 323121, male, aged 18 years, was admitted to the Baker Memorial Hospital on December 12, 1943, because of difficulty in swallowing, present since an early age. The exact nature of the injurious substance which this child swallowed was never discovered, but the characteristics of the injury to his esophagus were in every respect consistent with the ingestion of a solution of lye or some other corrosive substance. Dilatation of the esophagus had been performed on three separate occasions with temporary improvement, but each time he had again gradually become unable to swallow anything except liquids. He had lost 18 pounds in the 2 weeks immediately before he was seen.

Physical examination showed a tall, thin, malnourished, underdeveloped boy with a moderate



Fig. 4. Case 1. Roentgenogram of barium filled esophagus before operation. Lowest level of apparently normal esophagus is in the midthorax. There is almost complete obliteration of the lumen in the lower third.



Fig. 5. Case 1. Roentgenogram obtained after ingesta of barium after operation. The upper half of the stomach lies within the chest. The site of anastomosis is shown in the midthoracic region. It should be noted that the peritoneum observed along the lesser curvature side of the intrathoracic portion of the stomach is the result of the inversion of the cardia. The anastomosis is at the apex of the fundus.

pectus excavatum. Examination was otherwise negative. Blood pressure was 110-60.

Roentgen examination revealed a stricture of the lower third of the esophagus beginning at approximately the level of the inferior pulmonary vein and extending to the cardia.

Photo. hemoglobin was 14.5 grams, white blood count 7700. There were 64 polymorphonuclear leukocytes, 3 large lymphocytes, 20 small lymphocytes, 8 monocytes, 3 eosinophils, and 2 basophils. The red blood cells appeared fairly normal and the platelets were slightly increased. The nonprotein nitrogen was 20 milligrams per cent. The urine was normal. On December 20, 1943, a resection of the esophagus with esophagogastric anastomosis was performed. A long oblique incision was made across the left side of the chest and the ninth rib was resected. The chest cavity was opened. The lung appeared normal. There were no adhesions. The mediastinal pleura was incised behind the hilum of the lung, and the esophagus was gently freed. The area of stricture was identified opposite the level of the inferior pulmonary vein and extended from that point toward the cardia for a distance of several centimeters. This portion of the esophagus was rigid, thickened when palpated, but not very abnormal in appearance. When this area was dissected up, however, it was found that the outer coats of the esophagus were considerably thickened with scar tissue and the right vagus nerve was caught in scar tissue and

could not be freed. The fibers of the left vagus nerve were multiple and it was impossible to preserve more than a few of them.

The esophagus was cut across below the level of the stricture. The point of division actually went through the lower margin of this strictured area and in order to determine how high the lesion went, the proximal end was incised with the scissors. In this way it was found that the upper end of the diseased area, where the esophagus was completely denuded of mucous membrane, had a long tongue-like projection on the right posterior aspect of the lower inferior pulmonary vein. The esophagus was then cut across obliquely, the highest point of the incision being just above the point where this upward extension was and the lowest point being on the opposite side, namely the lateral aspect. The distal end of the esophagus was tied with heavy silk and inverted by means of a pursestring suture of 1/4 reinforced with a row of mattress sutures. The diaphragm was then opened through the hiatus. The attachments of the stomach to the diaphragm were freed. The vasa brevia were divided and in this way it was not necessary to remove the spleen. The stomach was long and it was therefore relatively easy to bring the fundus of the

stomach high in the chest. It was necessary, however, to divide the branch of the left gastric artery which extends toward the cardia. When this was done the fundus could be pulled up to the level of the aortic arch. A high esophagogastric anastomosis was then carried out, three layers of sutures being used. When completed the anastomosis lay above the inferior pulmonary vein at the level of the left main bronchus. The stomach was suspended in its new position by means of a row of sutures between it and the pleura along the side of the vertebral column.

The cut edge of the pulmonary ligament was sutured to the stomach. The diaphragm was then sutured around it so as to prevent herniation of other viscera and the remaining divided portion of the diaphragm was sutured to itself. The point at which the diaphragm was brought around the stomach was in the region of the antrum, not more than 4 inches proximal to the pylorus which had been pulled upward.

On pathological examination of the specimen a diagnosis of nonspecific ulceration and stricture formation was made.

The postoperative course was completely uneventful. Sulfadiazine, started on the day prior to operation, was omitted on the fifth postoperative day and he was discharged from the hospital in excellent condition on January 7, 17 days following operation. Roentgen examination showed a well functioning anastomosis just below the aortic arch.

The patient has reported for follow-up examinations at intervals since operation. He has no discomfort on swallowing. He has gained weight. He is active and leads a perfectly normal life. He experiences no dyspnea and no subjective symptoms which might be associated with the presence of his stomach in the chest except that sometimes after a large meal he has an awareness of his heartbeat.

CASE 2. R. C., MGH 453847, male, aged 5 years, was admitted to the Massachusetts General Hospital on August 28, 1944. In March of 1944 he had eaten some ice cream which had fallen into paint cleaner containing lye. He received burns about the mouth and tongue and was quite ill and unable to take food by mouth for a while. Subsequent to this he had been unable to eat anything except semisolid food. Roentgen examination in June had revealed a stricture of the esophagus and bouginage was carried out at weekly intervals during July and August. He was apparently well otherwise. He had a good appetite and ate well, but regurgitated almost everything he ate.

Physical examination showed a small, slender, male child in no distress. Nothing abnormal was found. Blood pressure 90/65.

Roentgen examination showed a stricture of the lower esophagus 10 centimeters in length. The upper margins were funnel-shaped. No definite ulceration was seen. The stomach was markedly dilated and there was delayed emptying, the cause of which was not determined.



Fig. 6. Case 2. Preoperative roentgenogram obtained after ingestion of barium, showing the stricture in the lower third of the esophagus. The proximal portion is dilated.

Laboratory investigation revealed a nonprotein nitrogen of 23.0 milligrams per cent, protein 6.4 milligrams per cent, and chloride 104.0 mcg/l. The white blood count was 9600, photo. hemoglobin 15 grams, red and white blood cells normal, platelets normal.

After a period of preoperative preparation including the administration of sulfadiazine and a transfusion, a transthoracic partial esophagectomy with esophagogastric anastomosis was performed on September 9, 1944. The chest was opened by means of an intercostal incision between the eighth and ninth ribs. In order to obtain better exposure the eight, seventh, and sixth ribs were divided posteriorly. The lower esophagus from the cardia upward for about 2½ inches was apparently normal. From this point up to the level of the left main bronchus there was a hard thickened area which was very adherent by chronic inflammatory adhesions to the surrounding mediastinal structures. Above this, for a distance of an inch and a half below the aortic arch, the esophagus appeared normal.

After freeing the esophagus sufficiently to make resection possible, the diaphragm was opened. The phrenic nerve was crushed. The stomach, which was large, was freed by dividing the left gastroepiploic vessels and the vasa brevia. There were some in-



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Fig. 7. Case 2. Roentgenogram obtained soon after operation showing the stomach high in the thorax and distended with air. Fluid level is within the stomach.



Fig. 8. Case 2. Lateral view same day as Figure 7 showing air-filled stomach in the chest. Fluid level is within the stomach.

inflammatory adhesions posteriorly which made the left gastric artery were divided. The esophagus was cut across just above the cardia and the stump was inverted into the stomach. Two layers of silk sutures were used to infold the stump. An anterior three layer, fine silk esophagogastric anastomosis was carried out above the level of the inflammatory stricture, and the diseased area was resected.

The fundus of the stomach was fixed in the chest by means of a number of sutures so as to prevent any pull upon the anastomosis. The pylorus was inspected and found to be apparently normal. The chest wall was closed around the stomach. The pericostal sutures of catgut in the first layer and interrupted silk in the remaining layers. No drainage was employed.

On pathological examination a diagnosis of chronic inflammation with ulceration was made. The patient's recovery from the operation was good. Chemical balance was well maintained. He received 1 ounce of water each hour on the second day following operation. Sulfadiazine had been begun on the day prior to operation and was continued until the fifth postoperative day. Roentgen exami-

nation of the chest 3 days after operation showed collapse of the left lung. This expanded gradually but completely. Roentgen examination following swallow of barium prior to discharge from the hospital showed a normally functioning stomach and marked improvement in the passage of barium through the pylorus into the duodenum. He left the hospital in good condition on September 30, 1944, 21 days after operation.

Since operation he has had no difficulty in swallowing. His weight gain has been slow, but investigation has revealed that his eating habits are poor and that the other members of his family are all of slight build.

CASE 3. O. C., MGH 490561, female, aged 27 years, was admitted to the Massachusetts General Hospital on October 11, 1945. She had been unable to swallow anything since January 21, 1942, when during a period of postpartum depression she had attempted to commit suicide by swallowing about a tablespoonful of Drano, which is a solution of lye used for cleansing drain pipes. Frequent dilatations had been attempted but were unsuccessful. After one acute dilatation the patient showed evidence of acute mediastinitis which resulted in the development of acute empyema on the right side. She recovered after rib resection for drainage. In March, 1944, a gastrostomy had been performed by means of



Fig. 9. Case 3. Preoperative roentgenogram after ingestion of barium. The upper level of the stricture is at the jugular notch. The entire thoracic portion of the esophagus is involved in extensive cicatrization and cicatricial obliteration. Note the shadow at a higher level in the neck thought at first to be barium within a diverticulum, but later proved to be the result of obstruction produced by a cicatricial web at that level.

which she could feed herself, but she was unable even to swallow her saliva and was kept awake at night by continual cough caused by this difficulty.

At the time of first examination, in July, 1944, she had been extremely thin, but in the interval between then and the present admission she had gained some 15 to 20 pounds. Physical examination was negative except for the presence of a scar of empyema drainage, performed in 1942, and an epigastric vertical scar with a 0.5 centimeter gastrostomy opening in excellent condition. Blood pressure was 108/94.

Roentgen examination revealed complete obstruction of the esophagus beginning at the level of the jugular notch where there was a funnel-shaped gradual narrowing. Below this point only a trace of barium could be seen to pass through. There was a shadow at the junction of the hypopharynx with the esophagus which was thought to indicate the presence of a pulsion diverticulum.

Laboratory studies showed a nonprotein nitrogen of 23 milligrams per cent, total protein 7.3 milligrams per cent, and a chloride of 94 milligrams per cent. The white blood count was 7200 and the Tall-

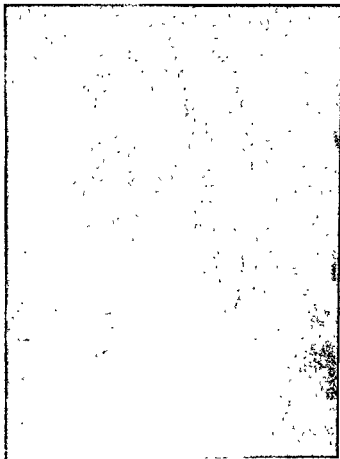


Fig. 10. Case 3. Roentgenogram outlining the stomach after completion of the second operation. The anastomosis lies at the level of the jugular notch.

quist hemoglobin 80 per cent. The urine was negative.

A transthoracic esophagectomy with a high esophago-gastric anastomosis was performed on October 16. The left side of the chest was opened and the eighth rib was resected. In order to gain adequate exposure for a subtotal esophagectomy, it was necessary to divide the seventh, sixth, fifth, and fourth ribs posteriorly. The mediastinal pleura was then incised and the esophagus was exposed. It was surrounded everywhere by a dense layer of thick fibrous tissue. This fibrous tissue, which prevented the development of planes of cleavage in which a dissection could be carried out, was thicker in some places than in others. It was particularly dense and difficult to dissect just below and behind the aortic arch. At this level, after a long and painstaking dissection from both above and below the arch, it was finally discovered that the esophagus had narrowed down to an extremely small circumference, having almost no evidence of a lumen at this level. Because it was so difficult to free it from the bronchus and lower end of the trachea at this point, the esophagus was finally cut from below and above the arch, a small portion being left attached. In this case the thoracic duct was inadvertently cut across, but it was recognized and each end was tied.

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The diaphragm had been previously opened so as to free up the stomach. The freeing of the stomach was completed by cutting the vasa brevia, the gastroepiploic and the left gastric vessels, and incising down the gastrocolic and gastrohepatic ligaments. The lower end of the esophagus was cut across. The distal stump was inverted with a silk pursestring suture reinforced with several mattress sutures of silk. The proximal end of the esophagus was pulled out from behind the aortic arch, and the upper limit of the stricture was found to be as shown by the x-ray at or slightly above the level of the jugular notch. This site necessitated pulling the fundus of the stomach up to the base of the neck. At this level a difficult three-layer anastomosis was performed between the cut end of the esophagus and the circular edge of stomach which remained after the excision of a small round piece. The posterior portion of the cut edge of the esophagus had some scar tissue in it, anteriorly the wall was more normal. After the anastomosis had been completed, the stomach which had been brought all the way up the length of the chest was sutured with a row of fine silk sutures extending from the apex of the chest down to the diaphragm. The diaphragm was then above the displaced pylorus. Penicillin was inserted both above and below the diaphragm. The wound was then closed in layers by means of silk, after a catheter was brought out through one of the lower interspaces.

On pathological examination a diagnosis of acute and chronic inflammation with ulceration was made. The patient's recovery from operation was good, but it was realized a week later that she still could not swallow as well as she should. At first she was able to swallow fluids well, but finally even this was difficult. There was obstruction to the passage of a Levine tube at the level of the sternal notch. An attempt was made at this time to have her swallow barium, but she was unable to do so. A roentgenogram obtained after the administration of a swallow of barium had on all previous examinations shown a shadow which was thought to indicate the presence of a pulsion diverticulum of the pharyngoesophageal junction. An attempt to visualize the anastomosis through an esophagoscope was unsuccessful. It was therefore concluded that there must be a stricture at the site of the anastomosis. It was decided to explore this by opening the esophagus through the diverticulum and to correct the difficulty by manipulation through this opening.

On December 11 an oblique incision was made along the course of the anterior border of the sternomastoid muscle on the left side. The usual exposure obtained, going in above the omohyoid muscle. There was no diverticulum to be found. A longitudinal incision was therefore made through the wall of the esophagus and on palpation downward an obstruction was met about halfway down the neck. The incision was then enlarged down to the jugular

notch and the entire length of the esophagus was exposed. In doing this it was necessary to divide the inferior thyroid vessels, the ansa hypoglossi nerve, the omohyoid muscle, and the lower attachments of the pretracheal muscles. The exposure was excellent, the pretracheal muscles were then incised below the ob-

The esophagus was then incised below the ob-  
structed point, and at this level the lumen was re-  
tiredly open and the mucosa normal. By palpation  
downward through the opening the index finger  
could be easily passed through the esophagogastric  
anastomosis which was not obstructed. The two in-  
cisions were then connected and the web-like  
stricture which had almost completely obstructed  
the lumen was incised and the resulting mucosal  
edges were sutured so as to restore the lumen to a  
normal diameter. Silk was used. The longitudinal  
incision was then sutured with three layers of silk.  
one in the mucosa, one drawing the edges of the  
muscularis together, and a third folding it in. Before  
this was done a soft Bardex catheter was inserted  
with the funnel-shaped end downward through the  
anastomosis, the tip end upward into the mouth, to  
be brought out through the nose after completion of  
the operation. Penicillin was then inserted in the  
deep spaces of the neck and behind the esophagus,  
and the wound was closed in layers with silk tech-  
nique without drainage.

The patient's convalescence following the second operation was completely uneventful. She was fed a liquid diet through the catheter until the tenth day when the catheter was removed. From that time on she was gradually allowed more and more food until the time of her discharge from the hospital when she was taking a liberal soft solid diet. She was dis-  
charged in excellent condition on the eighteenth day after the second operation. Roentgen examination following a swallow of barium showed the anastomosis to be functioning with no difficulty (Fig. 10). There was no delay in the passage of barium and the previously described narrowing of the cervical por-  
tion of the esophagus was no longer present.  
She has done well since returning home. She has reported by letter recently that she has no difficulty swallowing and that she can eat anything ever  
peanuts.

## RESULTS OF OPERATION

All three patients made a complete recovery, complicated in the third case by the necessity for a secondary operation for the relief of a previously unsuspected web-like stricture in the cervical portion of the esophagus. All have resumed a normal existence. The first patient, as a result of the operation has been able to eat normally for the first time since infancy. The second patient appears to be developing in a normal manner consistent with his age although he does not weigh as much as most children of his age.

The other two have gained in weight. In no case is the patient aware, so far as subjective sensations are concerned, that the stomach lies within the chest. The first patient, a rather high strung individual, occasionally experiences attacks of palpitation, usually as a result of excessive exertion soon after eating. He has been able however, to engage in competitive games and athletic exercises at school. All three patients are apparently perfectly well and free from physical handicaps.

#### SUMMARY AND CONCLUSIONS

The advantages of esophagectomy followed by the performance of an esophagogastric anastomosis are obvious and important. First, the procedure can usually be carried out in one stage. This not only diminishes the amount of discomfort and annoyance to the patient, but it should also shorten the period of hospitalization. In the second place, there is less interference with the normal relation of the parts of the upper alimentary tract to each

other. The food is delivered directly into the stomach instead of into the jejunum. Thus the amount of food which can be taken at one time is more nearly normal. From the subjective standpoint the patient is more comfortable and psychologically has the feeling that he has been restored functionally at least to a normal state. In cases of intractable stricture of the esophagus resulting from chemical burns, therefore, an esophagectomy followed by a high intrathoracic esophagogastric anastomosis is superior anatomically, physiologically, and psychologically to any form of external esophagoplasty as a method of restoring the functional continuity of the upper alimentary canal.

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# SUPPURATIVE CHOLANGITIS COMPLICATING SIDETRACKING OPERATIONS OF THE BILIARY TRACT

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**A**S a result of obstructive lesions of the extrahepatic bile ducts, it often becomes necessary to perform various types of sidetracking operations in order to divert the biliary stream. While this usually proves to be a safe and efficient procedure, serious complications due directly to the operation sometimes occur. By far the most hazardous complication is suppuration in the biliary tract.

## REVIEW OF THE LITERATURE

In 1882 Winiwarter performed the first sidetracking operation for obstructive jaundice in man, anastomosing the gall bladder and colon in seven stages over a 17 month period. Six years later, Oddi reported on his use of cholecystogastrostomy in dogs, noting that it was safer than cholecystenterostomy, since Harley and Gaston had 6 deaths in 7 cases in which the latter operation was done on dogs. The same year Riedel reported the first choledochoduodenostomy in man, and 2 years later Mayo-Robson (34) the first cholecystenterostomy, but in both cases the patients died. The first successful choledochoduodenostomy and cholecystogastrostomy in man were performed by Sprenkel in 1891 and Wickhoff and Angelberger in 1893, respectively.

In general the experimental evidence points to the fact that ascending infection in the bile ducts occurs in almost all cases in which direct cholecystogastrostomy or cholecystenterostomy is performed in dogs. Usually the severity of the infection is greatest when the colon is used and least when the duodenum or stomach is used (3, 12, 20, 22, 23, 47). By destroying all lymphatics communicating between the gall bladder and the liver in dogs, Lehman showed that the infection was due to regurgi-

tation from the gastrointestinal tract and not necessarily to spread via the lymphatics. Gentile alone presented experimental evidence to show that hepatitis or cholangitis does not complicate cholecystogastrostomy in dogs, while Weinberg, Wallin, and Binger noted the absence of this complication in monkeys.

The clinical evidence is not so conclusive. Michaux was one of the first to report a case of cholangitis following cholecystoduodenostomy. The inflammation developed 4 weeks after operation, and the patient died 1 month later. Kausch reported 2 cases in which cholecystojejunostomy was done for carcinoma of the pancreas and in which suppurative cholangitis developed 9 months and 4 months later, respectively. Wangenstein described in detail 1 case in which cholangitis developed 8 months after operation. Roeder reported 6 cases in which he performed sidetracking operations. In 2 of these cases, in which he did cholecystoduodenostomy, the patients did well, but of 4 patients who underwent cholecystogastrostomy, 2 died, one 10 days, and the other 74 days after operation. In both cases chills, fever, and jaundice developed. Mason and Baker reported a death due to abscesses of the liver 2 years after cholecystogastrostomy had been done. Eliason and Johnson noted that ascending infection was a complication of cholecystogastrostomy or cholecystoduodenostomy frequent enough to prevent their indiscriminate use. Brunschwig (5) and Whipple (42) also observed cholangitis after cholecystojejunostomy. Puestow, writing on spontaneous biliary fistula, refuted the belief that the formation of internal fistula relieved symptoms referable to the biliary tree. In the 16 cases on which he gave data, all but 4 patients had chills and fever, and all but 1 had recurrent jaundice. In the 1 case without jaundice the cystic duct

TABLE I.—COLLECTED LABORATORY DATA\*

	Date, 1945						
	March 31	April 9	April 12	April 16	April 20	April 25	April 28
Bile in urine†	2	1				5	
Leucocytes, per cu. mm. of blood	17,500	15,800			12,700		
Hemoglobin, gm. per 100 c.c. of blood	14.4	8.6		22.7	10.9		
Urea, mgm. per 100 c.c. of blood	50	28					54
Sugar, mgm. per 100 c.c. of blood	158	285					
Chlorides, mgm. per 100 c.c. of plasma	442	590	557	530	528		
Bilirubin, mgm. per 100 c.c. of serum	24.1 direct	22.2 direct	9.2 direct	27.7 direct		60 direct	63.2 direct
Protein, mgm. per 100 c.c. of serum	5.4	4.4	4.0	5.2	5.1		
Bile in stools	Neg.			Neg.			
Sedimentation rate (Westergren), mm. per hr.	00				50		

\*Operation performed April 6, 1945.

†On the basis of 1 to 4, in which 1 designates the least and 4 the greatest concentration of bile

was obliterated by inflammatory fibrosis, thus protecting the biliary tract from regurgitation of intestinal contents with resulting cholangitis. Colp recently reported that in 2 of 5 cases in which he performed hepaticoduodenostomy, chills and fever developed. In 1 case he did a Billroth II procedure to divert the gastric stream but symptoms continued.

In contrast to the foregoing unfavorable résumé, Mayo-Robson (35) expressed the belief that cholecystenterostomy is a safe procedure, basing his conclusions on 64 cases. White expressed a similar opinion for cholecystogastrostomy after his 3 patients did well. Babcock reported an additional 130 such operations, without evidence of postoperative ascending cholangitis. Moynihan cited 39 of his own cases and did not mention the complication. Steel went so far as to state that the gall bladder resists infection from the bowel. He expressed a preference for cholelithotomy followed by cholecystogastrostomy rather than cholecystectomy in cases of cholelithiasis. Judd and Parker, in discussing palliative procedures for carcinoma of the pancreas, stated, "It is expected that infection will result from direct extension or by the periductile lymphatics; this would not be likely to occur within the life expectancy period." Yet, in the same report, they stated that 2 of 62 patients who underwent operations for stenosis of the bile ducts and 1 of 9 patients on whom operation was performed for carcinoma of the bile ducts had chills, fever, and jaundice in the

postoperative period. Oppenheimer and his co-workers had no cases of cholangitis in their 34 cases of cholecystogastrostomy. Bardeleben, Kehr, and Bernhard also expressed the opinion that cholangitis is no serious objection to cholecystenterostomy, and Lehner stated his belief that cholangitis, even when it does develop, is not a serious complication, since it is only temporary.

Recently, a patient who had suppurative cholangitis shortly after direct cholecystogastrostomy had been performed for obstructive jaundice, came under our care.

#### REPORT OF CASE

A white man, 64 years of age, was admitted to the Mayo Clinic on March 31, 1945, with a history of abdominal pain for 1 year and jaundice for 6 months. The past history revealed only persistent glycosuria for 8 years. The present symptoms had started in July, 1944, with vague distress in the upper part of the abdomen, not related to meals and rather persistent. There were associated mild anorexia and some loss of weight. The patient stated that at that time he had been put on a special diet and given 40 units of protamine-zinc insulin and 20 units of regular insulin parenterally daily, since his physician had felt that his diabetes was responsible for the symptoms. In September, 1944, icterus, light stools, dark urine and intermittent vomiting developed. The jaundice cleared somewhat over the following weeks. As the result of roentgenologic studies a nonfunctioning gall bladder and a normal stomach had been reported. However, the symptoms continued, becoming worse 2 weeks before the patient came to the clinic. In addition, intermittent diarrhea developed.

Physical examination on admission to the clinic revealed severe icterus, an enlarged, tender liver, and

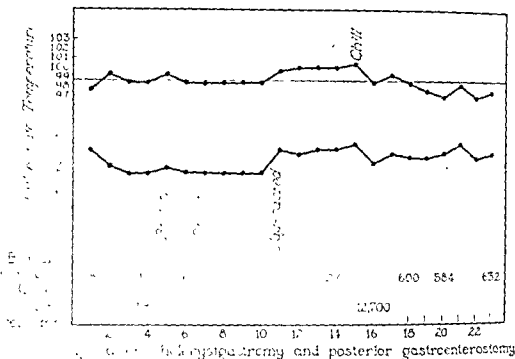


Fig. 1. Very mild constitutional reaction to suppurative cholangitis following cholecystogastrostomy. Patient died on twenty third postoperative day. Essential laboratory work is also included.

a palpable gall bladder. The temperature, pulse, and respirations were normal. The essential laboratory findings are included in Table I. On the basis of roentgenologic examination considerable dilatation of the stomach and first portion of the duodenum and a duodenal deformity in the region of the ampulla of Vater suggesting a neoplasm, not primary in the duodenum, were reported.

Operation was performed on April 6, 1945. A mass involving the head of the pancreas and the medial wall of the duodenum was found. This was producing obstruction of both the duodenum and the biliary tract. The liver was enlarged, very firm, and deep green. The gall bladder and the common duct were dilated considerably. There was some ascites. Posterior gastroenterostomy and direct cholecystogastrostomy were performed. The bile was clear and green. Five grams of sulfanilamide were left in the upper part of the abdomen.

The postoperative course is shown in Figure 1. The temperature was normal until the eleventh day, when it rose to 99.6 degrees—100 degrees F. and remained at this level for 5 days. The patient experienced a chill on the fifteenth day and the temperature rose to 100.4 degrees F. However, it promptly returned to normal. It rose again to 99.4 degrees F. on the seventeenth day for a single reading but soon returned to normal and remained normal or subnormal until death which occurred on the twenty-third day.

On the fifth day edema of the legs and feet, attributed to hypoproteinemia, developed. Consequently, the patient was placed on a high protein

diet supplemented by oral administration of 54 grams of amigen (an enzymatic hydrolysate of casein), daily. There was some clearing of the edema. On the eighth day there was drainage of bile-stained ascitic fluid from the incision, and the patient complained of pain in the right shoulder attributed by us to diaphragmatic irritation, possibly from a leak at the anastomosis, which did not heal well as a result of the hypoproteinemia.

The jaundice at first seemed to be clearing and the stools regained color. On the eleventh day, when the temperature rose, the stools again became acholic and the icterus deepened. The serum bilirubin level rose to 60 milligrams per 100 cubic centimeters direct, remaining at this level until death. It was felt that the increasing jaundice was due to a stricture at the site of cholecystogastrostomy, following a leak on the eighth day.

At necropsy the interesting findings were limited to the upper part of the abdomen. The liver was enlarged and brownish green and its surface was studded with small abscesses. These were most numerous on the diaphragmatic and posterior surfaces. The intrahepatic and extrahepatic bile ducts were greatly dilated and were filled with thick yellow pus and granular material. The pancreas had a carcinoma in the head obstructing the pancreatic and common bile ducts. There was evidence of infection around the head of the pancreas. The anastomoses were patent and the suture lines intact. Microscopic examination of the organs confirmed the gross anatomic impressions and also revealed a few small metastatic regions in the liver.

TABLE II.—FREQUENCY OF CHILLS AND FEVER IN 209 CASES OF SIDETRACKING OPERATIONS FOR MALIGNANT OBSTRUCTION OF THE BILIARY TRACT (1937-1943)

Operation	Chills and fever before operation	Chills and fever before and after operation*	Chills and fever after operation
Cholecystogastrostomy	10	0	12
Cholecystoduodenostomy	1	1	0
Cholecystojejunostomy	0	0	1
Choledochogastrostomy	0	0	0
Choledochoduodenostomy	4	1	1
Choledochojejunostomy	1	0	0
Totals	16	2	14

\*These cases are included among the cases in the preceding column.

The true nature of things was not fully appreciated before the death of the patient. It was felt that there was either a stenosis of the anastomosis between the gall bladder and the stomach or a metastasis in the hilus of the liver producing further obstruction of the biliary tract. The relatively normal post-operative temperature, the only slightly elevated neutrophil leucocyte count and the absence of more than only a single mild chill all argued against suppuration. That the infection developed following the operation is supported by the finding of clear bile in a dilated, although otherwise normal biliary tract at the time of operation, whereas at necropsy not only was the tract dilated but the walls were thickened and the lumen was filled with thick creamy pus. It is well to recall that the anastomoses were patent. *While in most cases of stricture of anastomoses of this type: cholangitis does develop, the formation of stricture is not necessary for the development of cholangitis.* In a significant percentage of cases in which necropsy was done following death at variable times after sidetracking operations, cholangitis of greater or less degree was present without an obstruction.

While it may appear that the absence of chills, fever, and increasing jaundice in the postoperative period would argue against inflammation in the biliary tree, this is not necessarily true. Walters and Snell stated that "the gravity of the symptoms is not always an index of the degree of suppuration, and in many cases extensive purulent infection

TABLE III.—RESULTS OF 209 SIDETRACKING OPERATIONS FOR MALIGNANT OBSTRUCTION OF THE BILIARY TRACT (1937-1943)

Operation	Chills and fever before operation		No chills or fever before operation, cases	Chills and fever after operation only, per cent*
	Total cases	Cured by operation, per cent		
Cholecystogastrostomy	10	100	130	9
Cholecystoduodenostomy	1	0	11	0
Cholecystojejunostomy			11	8
Choledochogastrostomy			1	0
Choledochoduodenostomy	4	75	20	3
Choledochojejunostomy	1	100	1	0
All operations	16	88	101	7

\*Percentage of cases in each group in which there were no chills and fever before operation.

of the biliary passages may develop with only minor systemic manifestations. This is especially true of the cholangitis which may develop in association with stone or stricture. It has been observed many times that actual suppuration in the bile passages may occur without fever."

This fact may well explain the discrepancy between the experimental evidence of almost constant suppuration and the clinical reports by many physicians of the absence of any infection. In experimental work all the animals are subjected to careful postmortem study and no cases of cholangitis are overlooked, whereas only a very small number of human beings are ever so studied. Only at the operating table or at necropsy can a definite diagnosis be established. It is very likely that in many cases that follow a course similar to the one presented here, or in which at first the patient appears to do well after sidetracking operations for malignant obstruction of the biliary tract and then progressive jaundice attributed to hepatic metastasis develops, there is in reality suppurative cholangitis, never recognized because necropsy is not performed after death. In view of this, all figures for the incidence of cholangitis must be looked on as lower limits of the actual incidence.

#### INCIDENCE OF CHOLANGITIS

Following the case reported here, it was decided to attempt to determine, as accurately



TABLE IV.—FREQUENCY OF CHILLS AND FEVER IN EIGHTY-TWO CASES OF SIDETRACKING OPERATIONS FOR BENIGN OBSTRUCTION OF THE BILIARY TRACT (1937-1938)

Operation	Chills and fever before operation	Chills and fever before and after operation*	Chills and fever after operation only
Choledochoduodenostomy	16	4	10
Cholecystogastrostomy	3	1	0
Cholecystoduodenostomy	1	0	0
Choledochogastrostomy	2	0	0
Cholecystojejunostomy	0	0	0
Hepaticoduodenostomy	1	1	6
Hepaticogastrostomy	1	0	1
Hepaticojejunostomy	1	1	1
Totals	25	8	18

\*These cases are included among the cases in the preceding column

as possible, the incidence of cholangitis developing after sidetracking operations for malignant obstruction of the biliary tract. It was also felt that we might determine how often chills and fever associated with malignant obstruction of the common bile duct were relieved by such procedures. The only way, short of operation or postmortem examination, that we know by which cholangitis after sidetracking operations can be suspected is on the basis of the symptoms of chills and fever, with or without associated jaundice, leucocytosis and increased sedimentation rate. The presence of chills and fever associated with jaundice or biliary colic before operation is also presumptive evidence of cholangitis. We, therefore, used chills and fever as specified as the criterion by which we diagnosed cholangitis, when we were certain that the symptoms were not due to any other factors. All such cases in which operation was performed during the years 1937 to 1943, inclusive, were chosen. There were 209 such cases. In addition, a series of cases of benign lesions, during 1937 and 1938, was investigated to compare the results. There were 82 such cases. The findings are summarized in Tables II to V, inclusive.

It is noted from an analysis of these figures that 88 per cent of these patients who had preoperative chills and fever associated with malignant obstruction of the bile ducts were

TABLE V.—RESULTS OF EIGHTY-TWO SIDETRACKING OPERATIONS FOR BENIGN OBSTRUCTION OF THE BILIARY TRACT (1937-1938)

Operation	Chills and fever before operation		No chills or fever before operation, cases	Chills and fever after operation only, per cent*
	Total cases	Cured by operation, per cent		
Choledochoduodenostomy	16	75	31	31
Cholecystogastrostomy	3	33	9	0
Cholecystoduodenostomy	1	100	1	0
Choledochogastrostomy	2	100	1	0
Cholecystojejunostomy			1	0
Hepaticoduodenostomy	1	0	8	75
Hepaticogastrostomy	1	100	1	100
Hepaticojejunostomy	1	0	1	50
All operations	25	68	57	31

\*Percentage of cases in each group in which there were no chills and fever before operation.

cured of these symptoms, whereas 7 per cent of those who, before operation, had not had symptoms suggesting cholangitis manifested such symptoms at variable times after operation. In addition, in 14 cases cholangitis developed following, or as a result of the operative procedure, and in only 2 cases in which chills and fever had been present preoperatively did these symptoms continue postoperatively. A similar observation is made when dealing with the benign strictures of the common duct, 68 per cent of patients (17 of 25) being relieved of their symptoms by operation and 32 per cent (18 of 57) manifesting these as new symptoms after operation. This latter percentage is considerably higher than that in the malignant group. However, the average life expectancy of the malignant group was very short (a matter of months), whereas that of the benign group was much longer. Is it not likely that had the patients who had malignant lesions lived longer, the figure would have been higher? This may be surmised, since many of the patients in the benign group who manifested chills and fever did not do so until, in some cases, years had elapsed.

It is also observed that just as many patients in the malignant group had symptoms after operation as before; namely, 16. However, only 2 patients fell into both groups. In

other words, 14 patients were cured of their symptoms and 14 others did not have these symptoms until after operation. Unless the figures are broken down in this manner, this fact is not recognized. The usual observation is merely that cholangitis is present just as often before, as after operation. The most significant observation, then, is missed.

It is rather difficult to explain why the same operation should relieve symptoms in some cases and produce them in others. This may be due to the fact that the patient who has cholangitis associated with obstruction has acquired some resistance to infection, and when the obstruction is overcome and internal drainage is established, resolution takes place. On the other hand, the patient who has not had previous cholangitis suddenly has his dilated biliary tract exposed to intestinal bacteria, in the absence of any previous immunization. Rapid suppuration in such a biliary system follows. This explanation of regurgitation as the cause for postoperative cholangitis is more likely than stricture formation alone, since there is no reason why strictures should develop more often in patients without cholangitis before operation than in those who have cholangitis before operation.

The conclusion that we draw from our analysis of the figures is that if there were means of preventing such postoperative complications from developing, the value of sidetracking procedures would be enhanced manifold. This is even more true for the benign group, in which the patients are often young, the operative mortality rate is not prohibitive, and the patients do live for a reasonable time after operation.

#### PREVENTION OF POSTOPERATIVE CHOLANGITIS

Attempts to prevent cholangitis from developing after anastomotic operations between the biliary tract and the intestine or the stomach are not new. In 1904, Monprofit suggested the performance of cholecystenterostomy in the form of a Roux procedure, dividing a loop of jejunum, using the distal segment for the anastomosis and then connecting the proximal to the distal loop further down as an end-to-side procedure. Whipple(43) also used this operation, and in one such case

in which the patient died 6 months later, no cholangitis was found at necropsy. Eliot expressed the opinion that the use of cholecystogastrostomy rather than cholecystenterostomy would reduce the incidence of cholangitis. However, Mason was the first to report anastomosing the gall bladder to the stomach in such a manner that the former tunneled its way through the wall of the stomach before it reached the gastric lumen. In this way gastric peristalsis would obliterate the lumen of the gall bladder and thus prevent regurgitation of gastric contents. Roeder, DeBakey and Ochsner, Glassman, Zollinger, and McCaughan and Purcell reported favorably on various modifications of the Mason procedure. Although the operations were done on only a few patients, these authors noted the absence of cholangitis in large numbers of dogs on which this operation was performed, while the incidence of cholangitis was high in dogs on which direct cholecystogastrostomy was performed.

In 1941, Hunt and Whipple(43) suggested using the common bile duct rather than the gall bladder, and anastomosing it to the jejunum. In their opinion the common duct would be more resistant to infection since the pressure within it was greater than in the gall bladder. In 1943, Brunschwig, reporting a one stage pancreatoduodenectomy, performed just such a choledochojejunostomy, protecting the biliary passages still more by anastomosing the afferent and efferent jejunal loops in order to divert the intestinal stream. Orr recently emphasized another principle in performing pancreatoduodenectomy: "... location of the anastomosis between the gall tract and pancreas and the jejunum proximal to the gastrojejunosomy to prevent infection of the gall tract and pancreas." Combining several of the methods mentioned previously, Cole and Reynolds stressed the fact that choledochenterostomy should be done, and placed first in the line of anastomosis. They mentioned 2 cases in which chills and fever stopped when they interrupted, by a Roux procedure, the loop of jejunum which allowed reflux of food through a vitallium tube. They also suggested partly folding in the wall of the loop of jejunum anastomosed to the biliary tree in such a

manner as to make valves to direct the flow of contents away from the anastomosis of the biliary tract to the jejunum.

All of the procedures mentioned are concerned with preventing regurgitation of intestinal contents, the feeling being that cholangitis developing after the sidetracking operations more commonly performed is often due to direct regurgitation, rather than secondary to stricture of the anastomosis. As previously mentioned, necropsy does reveal a rather high incidence of cholangitis after the usual sidetracking operations in the absence of stricture.

As yet, not enough cases have been reported to help us to come to any definite conclusion as to the value of any of the procedures mentioned previously. Surely, the operations as usually done are far from satisfactory.

#### CONCLUSIONS

1. Severe suppurative cholangitis may be present in the absence of marked constitutional or local symptoms.

2. Any patient who has mild systemic symptoms in the immediate postoperative period after biliary-gastrointestinal anastomosis should be suspected of having suppurative cholangitis, in the absence of other evidence to explain these signs and symptoms. This is especially true if there is associated progressively deepening jaundice.

3. Most patients who have cholangitis associated with obstructive jaundice are relieved of their symptoms after sidetracking operation but an appreciable number of patients who previously did not have chills or fever have these symptoms after such operation. These circumstances are very likely often the result of regurgitation of intestinal contents.

4. Surgical procedures designed to prevent and relieve cholangitis following sidetracking operations for obstructive jaundice are described. The authors quoted reporting these operations stress the prevention of regurgitation of gastrointestinal contents and minimize the rôle of stricture formation in the development of postoperative cholangitis.

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# THE SURGICAL SIGNIFICANCE OF AORTIC ARCH ANOMALIES

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IN spite of the complex changes which occur in the fetal vascular network, it is a remarkable provision of nature that such constancy is attained for man in the development of the normal aortic arch and its important branches. It is not surprising that this intricate maturation is occasionally disturbed and some sort of a local malformation is evolved. For more than 200 years medical literature has contained reports of aberrations in development of the arch or of the arteries leading from it. Most of the earlier observations were made by anatomists or pathologists, but within the last two decades there have been frequent attempts to correlate the complaints or the clinical findings in patients with the pathological anatomy which is later detected at the autopsy table. More recently the roentgenologist has provided techniques for recognition of many of these malformations in the living subject. It now becomes incumbent upon the surgeon to provide methods of operative relief whenever this might be required and when it appears feasible.

In the following presentation there has been no effort to discuss, or even mention, all of the anatomical variations which have been observed in the aortic arch and its major vessels. Instead, we have selected only the more common abnormalities which seem to have some possibility of surgical correction or which have been already improved by the operative procedures which are listed. Our studies in this field have been stimulated and advanced by the intelligent guidance of conferees, particularly by Dr. Sidney Farber and his aides in the pathological laboratory and by Dr. E. B. D. Neuhauser in the department of roentgenology.

In a consideration of the congenital malformations of the aortic arch, it is well to

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begin with some sort of a classification. The following has been used as a working basis; we are cognizant of its defects and omissions, but have employed it because it affords a logical grouping from which our discussion can start.

## CLASSIFICATION OF AORTIC ARCH ANOMALIES

1. Right aortic arch
  - A. Situs inversus viscerum
  - B. Right aortic arch without inversion
    1. Anterior type—arch is anterior to the trachea. Descending aorta is right-sided.
    2. Posterior type—arch passes to the left behind the esophagus. Descending aorta courses to the right of normal left side position.
      - a. Right aortic arch in which the left subclavian artery arises last from the arch and crosses behind the esophagus (Fig. 1)
      - b. Right aortic arch in which no vessel arising from the arch crosses the midline posterior to the esophagus. A vessel may pass in front of the trachea (Fig. 2)
      - c. Right aortic arch with a persistent left aortic diverticulum giving origin to the left subclavian artery and ligamentum arteriosum (Fig. 3)
2. Double aortic arch
  - A. One aortic limb obliterated
  - B. Both aortic limbs patent (Fig. 4)
3. Anomalous right subclavian artery. Arises from the left side of a normal aortic arch and crosses the midline, compressing the esophagus (Fig. 5)
4. Patent ductus arteriosus (Fig. 6)
5. Coarctation of the aorta (Fig. 7)

## RIGHT AORTIC ARCH

A right aortic arch represents a persistence of the right 4th branchial artery—instead of the left one, which normally forms the fully developed arch in man. In this malformation, the aorta arises in a more or less normal way from the left ventricle and then it courses posteriorly over the right main bronchus. From here it extends in front of the trachea (in the rare "anterior type") and then con-

tinues downward behind the lung root as a right-sided aorta. In the more common "posterior type" the arch passes to the left behind the esophagus and the descending aorta continues downward—not on the right side—but in a position somewhat to the right of its normal position.

Great variations can be found in the origins and the courses of the vessels which come from a right aortic arch. We do not care to describe all of these, for fear of introducing too much confusing data. The classification which has been adopted for right aortic arch cases is by no means inclusive; it is intended to present only the more common malformations.

*A. Situs inversus viscerum.* These cases are possibly improperly classified under the term of "right aortic arch" since they merely represent a side-for-side reversal of the heart and its vessels. In conjunction with this may be a *situs inversus* of the abdominal organs, but it is more common to have the reversal limited to the heart and aorta. This type of anomaly usually presents no symptoms.

*B. Right aortic arch without inversion.*

1. *The anterior type.* The ascending aorta rises to the right over the right main bronchus, the second portion lies in front of the trachea, and the descending part passes downward to the right of the midline. Such an anomaly is rare and is encountered primarily in association with transposition of the great vessels.

2. *The posterior type.* In all of these cases the aorta extends posteriorly to the right of the trachea and esophagus, and then to the left behind the esophagus, continuing downward in a place which is a little to the right of the normal alignment. This posterior type may be subdivided into three general groups, as summarized in the classification. In each of these three divisions there are certain features in the way of esophageal or tracheal compression which probably can be recognized by roentgenologic studies in a living patient.

In group 2a, and as depicted in Figure 1, a major portion of the arch lies behind the esophagus, but in addition, the posterior wall of the esophagus above this is indented obliquely by the left subclavian artery which

has an origin low down on the back side of the arch. Furthermore, the left common carotid artery is apt to originate to the right side of the midline and to course over the anterior surface of the trachea.

In group 2b, and as shown in Figure 2, the arch lies transversely behind the esophagus and no other vessel courses in back of the esophagus. The left common carotid artery can cross in front of the trachea and compress it. Frequently, the left common carotid artery and the left subclavian artery arise from a left innominate artery (a minor image of a normal arch and vessels). The pulmonary artery, by virtue of its attachment through the ligamentum arteriosum (or a patent ductus arteriosus) to the posteriorly displaced aortic arch, is pulled backward and pushes on the trachea.

In group 2c, a general arrangement and disposition of vessels can be found as indicated in Figure 3. The important feature here is a so-called "aortic diverticulum"—of variable size—which is an outpocketing of the distal part of the arch and which gives rise to the left subclavian artery and to the ductus arteriosus (or the ligamentum arteriosum).

The various types of right aortic arch may give little or no symptoms and they are frequently of only academic interest. Eisen found 8 right aortic arches in 288 fluoroscopies of the chest for other pathology; in no case were there symptoms referable to the anomalous arch. It is possible, however, for a variety of complaints to come from these regional malformations—as is testified by many reports including those of Renander, Sprague *et al.*, Spencer and Dresser, Garland, Metzger and Ostrum, Faber *et al.*, and also by the patient described below as Case 1. There may be dysphagia, stridor, dyspnea, cyanosis, and hoarseness, cough, pain in the upper chest, and vague sensations in the arms. From a study of pathologic specimens and from illustrations such as Figures 1, 2, and 3, it is clear that symptoms may be derived from the arch behind the esophagus, from the great vessels which cross behind the esophagus or in front of the trachea, from a large aortic diverticulum, or from a pulmonary artery which is held posteriorly by its attachment to the arch.

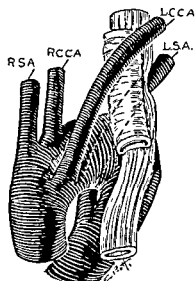


Fig. 1.

Fig. 1. Right aortic arch, with left subclavian artery arising last from the arch and crossing behind the esophagus. *L.C.C.A.*, left common carotid artery; *L.S.A.*, left subclavian artery; *R.C.C.A.*, right common carotid artery; *R.S.A.*, right subclavian artery.

Fig. 2. Right aortic arch, with no vessel from the arch crossing behind the esophagus. Left common carotid artery compressing front of trachea. Pulmonary artery drawn tightly against the trachea by the ductus arteriosus. Case 1, a baby who died from the effects of esophageal and tracheal obstruction. *L.C.C.A.*, left common carotid

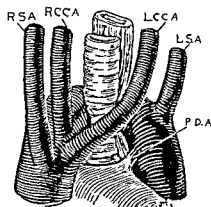


Fig. 2.

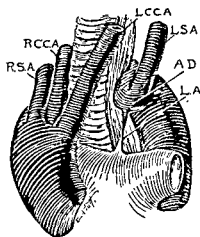


Fig. 3.

artery; *L.S.A.*, left subclavian artery; *P.D.A.*, patent ductus arteriosus; *R.C.C.A.*, right common carotid artery; *R.S.A.*, right subclavian artery.

Fig. 3. Right aortic arch with persistent left aortic diverticulum giving rise to the left subclavian artery and the ligamentum arteriosum. Frequently the aortic diverticulum is longer than is indicated here. *A.D.*, aortic diverticulum; *L.A.*, ligamentum arteriosum; *L.C.C.A.*, left common carotid artery; *L.S.A.*, left subclavian artery; *R.C.C.A.*, right common carotid artery; *R.S.A.*, right subclavian artery.

As far as surgical therapy is concerned, none has ever been attempted that we are aware of. It is permissible to surmise that relief could be afforded in some instances when the symptoms are severe enough to warrant such an undertaking. Clearly, many of the local vascular conditions cannot be changed, but at least three possibilities are worthy of consideration. Arteries (such as a subclavian or common carotid) which impinge on the esophagus or on the trachea could be divided or displaced in such a way that this pressure is relieved. An aortic diverticulum, if it is very long, could be removed (and the first part of the left subclavian artery sacrificed); in this way compression of the esophagus could be diminished. A ligamentum arteriosum (or a patent ductus arteriosus) could be divided and thus allow the pulmonary artery to fall forward and away from the trachea.

CASE 1. M. O'D., a 4 month old baby, entered the hospital because of difficulty in breathing and feeding since birth. Mucus frequently collected in the throat and gave rise to severe bouts of coughing, but the infant never became cyanotic. Excessive mucus

and coughing were more troublesome when the child was lying on her back. When she was picked up, or her position was changed, these difficulties improved somewhat. Since birth, there had been hesitation in swallowing, and this had become more marked in the month preceding hospitalization. If urged to take more than 1 or 2 ounces she invariably vomited part or all of the previously ingested feeding. Physical examination revealed a poorly developed but fairly well nourished baby. When she was disturbed, the respirations became quite noisy and there was an inspiratory crow. Roentgenographic examination of the chest revealed some peribronchitis. With a swallow of barium in the esophagus, a filling defect could be seen on its posterior wall at the level of the 3rd or 4th thoracic vertebra. The trachea was narrowed just above the carina.

The child regurgitated most of the milk which was offered; gavage was unsuccessful. Because of the precarious state of health, a gastrostomy was performed for feeding purposes. Evidence of pulmonary infection increased and, on the fifth postoperative day the baby died.

Postmortem examination was confined to the chest. There were present a diffuse, severe bronchopneumonia and early bilateral emphysemas. The foramen ovale was still patent. The aortic arch and its respective vessels were found as indicated in Figure 2. There was thus a vascular ring around the esophagus and trachea, formed by the aortic arch behind, the ductus arteriosus on the left, and by the pul-

monary artery in front. In addition, the left common carotid artery apparently compressed the anterior surface of the trachea to some degree. The autopsy findings strongly suggested that the baby might have been relieved by division of the ductus and also by severance of the left common carotid artery (or as an alternative, the carotid artery could have been moved forward and anchored to the back of the sternum).

#### DOUBLE AORTIC ARCH

Double aortic arch is a rare abnormality in which the ascending aorta splits into two limbs—which encompass the esophagus and trachea, or only the trachea—and then join to form the descending aorta. In normal development, only the left fourth branchial arch persists to form the definitive arterial system according to Congdon. If the right and left branches both remain, a double arch is established. (A bifid aortic arch is the normal arrangement in reptiles.) Such abnormalities in man may be divided into two groups, the first being less common than the second:

*A. Partially obliterated double aortic arch.* One limb—usually the anterior (left) one—is represented only by a vestigial remnant or cord. The other trunk is patent and functional.

*B. Completely patent double aortic arch.* Both limbs are open and each carries some blood to the descending aorta (Fig. 4a). The two trunks may be of the same size but they are apt to be unequal. Lockhart studied one specimen in which the right and left arches were equal in caliber—a very rare finding. Blincoe *et al.* collected 12 cases of double aortic arch, in 9 of which the sizes of the respective branches were noted as follows: in 3 cases, the left arch was 15 per cent smaller than the right; in 3 cases, the left arch was 50 per cent smaller than the right; and in 3 cases, the left arch was quite small, but was still patent. The division of the aortic arch into two channels implies that these surround some mediastinal structures. Malacarne, Sagorski, and Welch described enclosure of the trachea alone, but in all other observations both the esophagus and trachea have been encircled.

It is evident that the confinement of the esophagus and trachea between the two limbs

of a split aortic arch has the potentialities for interference with function of these two tubes. Whether or not symptoms develop depends entirely upon the amount of available room which exists between the two vessels. If sufficient space is present there will be little or no compression of the esophagus and trachea—and the individual can live to an advanced age without symptoms, as is exemplified by the patient of Curnow and others. If, however, the space between the aortic limbs is small, the esophagus and trachea can both be constricted so that serious complaints—or even fatality—result therefrom. If complications appear, they are apt to very do so in early life, usually in infancy. Wolman made an excellent study of 7 cases—all infants under 8 months of age—in each of which there was dysphagia and stridor beginning in the neonatal period, and in each there was death from a pulmonary infection. To these patients with symptoms can be added our 2, both of whom were treated surgically. The first of these has been reported elsewhere (13), the second is included herewith as Case 2.

Wolman has very well described the clinical picture which is presented by these infants, and our experiences closely corroborate his observations. Dysphagia and especially stridor occur shortly after birth and persist. These may be mild or they may be severe and continue until death supervenes or surgical relief is instituted. The respirations are noisy and wheezing; they may even have a crowing quality. Suprasternal and intercostal retraction is common. The child is subject to spells of harsh, nonproductive coughing. The cry is hoarse. The respiratory rate is often elevated. During the act of deglutition, stridor is accentuated and cyanosis sometimes appears. Feedings require much time and patience, since swallowing is delayed and the baby must rest at frequent intervals to improve the breathing. The nourishment and general development may be reasonably good, but these patients are quite subject to superimposed respiratory infections. It is this latter factor which accounts for most of the fatalities. Presumably, the tracheal compression—and possibly the spill-over from

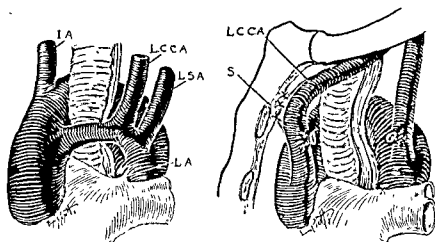


Fig. 4. a, left, Double aortic arch. The ascending aorta divides into two limbs which subsequently join and form the descending aorta. The esophagus and trachea are compressed (Case 2). b, Method of surgical treatment which was employed. The ligamentum arteriosum has been divided to allow the pulmonary artery to fall forward. The anterior (left) limb of the double arch has been severed between the origins of the left common carotid artery and the left subclavian artery. The left common carotid artery is then tacked to the back of the sternum to keep it off the trachea. I.A., innominate artery; L.A., ligamentum arteriosum; L.C.C.A., left common carotid artery; L.S.A., left subclavian artery; S., sternum.

the esophagus—initiate repeated bouts of tracheobronchitis and pneumonia.

Fortunately, the diagnosis of this condition can be readily made during life by roentgenologic means. We are indebted to Dr. E. B. D. Neuhauser for detection of the anomaly in our 2 patients while they were still in a reasonably satisfactory physical condition and could be brought to operative treatment. If the condition is suspected, a swallow of barium and appropriate observations in the lateral and anterior-posterior views will quickly indicate whether there is a compression defect on the posterior esophageal wall. If this is found, films of appropriate density will outline the trachea (because of its air content) and any narrowing can be observed. If the trachea cannot be seen by this simple method, instillation of lipiodol or the use of a lipiodol spray will permit its visualization.

Surgical therapy for this abnormality does not appear to be very difficult. The posterior (right) aortic limb cannot be removed from behind the esophagus, since it is usually the larger of the two channels. However, by dividing some part of the anterior (left) limb, the vascular ring can be broken, the pressure on the trachea can be diminished, and the esophagus can be allowed to displace forward

to some degree. In our first case (13) this was the only procedure which was carried out. It provided a marked alleviation of respiratory difficulties, but it did not abolish them. The residual symptoms were thought to be due to the stretching of the left common carotid artery across the upper part of the trachea like a bowstring. To obviate this factor in our second case, the anterior aortic limb was divided (Fig. 4b) and then the left common carotid artery was held forward (off the trachea) by tacking it to the back of the sternum with a few stitches. This additional step has proved to be worth while because the baby has been completely relieved. (In some cases it might be possible to divide the anterior limb between its source and the origin of the left common carotid artery, and in this way the left common carotid artery would be made to lie alongside the trachea instead of stretching across in front of it. Such a division was not done in our two cases because the distal part of this limb seemed to be too small to supply adequately the left subclavian artery and the left common carotid artery. In short, the size of the various parts of the limb must determine where it will be cut.)

CASE 2. C.A.G., a 5 month old baby, entered the hospital in June, 1945, because of stridor, cough,



fever, and respiratory infection of 2 weeks' duration. The child was cyanotic and in marked distress. The breathing was noisy and rapid; there was marked intercostal retraction. She was placed in a steam room and was given oxygen, penicillin, and sulfadiazine. For 2 days her condition was critical enough to require various stimulants, but following this she gradually improved and was discharged on the 19th day.

Following hospitalization, the baby was in fair condition for several weeks and then again developed a cough and noisy respirations, but was afebrile. Because of progressive anorexia and weight loss, hospitalization was again advised in August. Auscultation revealed rhonchi over both lung fields. The breathing was noisy and stertorous. Roentgenographic studies showed indentation of the esophagus from behind (at the level of the 3rd dorsal vertebra) and an anterior compression of the trachea at the same level.

At operation, an anterior exposure through the left pleural cavity permitted dissection of the superior mediastinum so that the arrangement of the vessels could be accurately ascertained (Fig. 4a). Because of the size of various portions of the anterior (left) limb of the double arch, it seemed best to divide it between the origins of the left subclavian artery and the left common carotid artery. This latter vessel then seemed to stretch across the anterior surface of the trachea at a higher level, and to avoid all such pressure the artery was now lifted off of the trachea and held forward by suturing its adventitia with several silk stitches to the periosteum on the back of the sternum. During the first part of the operation the child's respiratory movements were labored, greatly accentuated, irregular, and noisy—a fact which greatly enhanced the anesthetist's difficulties. However, when the indicated operative steps were completed, the respirations were quiet and entirely normal. The left lung was re-expanded and the chest was closed.

Following operation the residual respiratory infection rapidly responded to treatment and the child was discharged on the 12th day. Since that time the baby has been normal in every way. She swallows without hesitation and has had no stridor or other respiratory symptoms at any time. There has been a rapid gain in weight and the parents are delighted with the operative result.

#### ANOMALOUS RIGHT SUBCLAVIAN ARTERY

One of the commonest anomalies of the aortic arch is that in which the right subclavian artery arises from the left side of the arch and then courses upward and to the right to reach its normal exit from the thoracic cage (Fig. 5a). This artery may run behind the esophagus, between the esophagus and trachea, or in front of the trachea. Holzapfel made an extensive study of this anomaly and

found the artery to lie: behind the esophagus in 107 cases, between the esophagus and trachea in 20 cases, in front of the trachea in 6 cases. The vessel usually crosses the midline of the body at the level of the third dorsal vertebra. Holzapfel and others have commented upon the frequency with which an aneurysmal dilatation is found in the first part of the artery—just as it comes off the aortic arch. The appearance of a subclavian abnormality is reported to range from 4 cases per thousand dissections (Quain) to 16 per thousand postmortem examinations (Goldbloom). Holzapfel attributes the first authentic case report to Hunauld in 1735. In 1794 Bayford made a precise and fascinating description of a woman who was known to have marked difficulty in swallowing for many years and who at autopsy was proved to have esophageal compression from this malformation. It was he who gave the name of *dysphagia lusoria* to this condition—meaning thereby that the dysphagia was due to a *lusus naturae* (a trick or deception of nature).

This anomalous vessel may not give rise to any symptoms—indeed it does not do so in the vast majority of cases. It has been frequently described as an incidental finding in dissection room subjects, or in postmortem examinations of elderly individuals who apparently did not have any alteration of esophageal function. More recently, it has been noticed in an incidental way during roentgenologic examinations of the alimentary tract. It is possible, however, for the vessel to press upon the esophagus and to disturb the swallowing mechanism. In Kirby's patient a swallowed bone stuck in the esophagus where the vessel crossed it; a perforation of the subclavian artery led to fatal hemorrhage. The 3 year old patient of Vellock *et al.* died in acute respiratory distress because food had become lodged in the esophagus at this point. In our experience this abnormality has been identified in 6 patients by the roentgenologist. In 4 of these children there seemed to be no important difficulty in swallowing. In the fifth there was sufficient hesitancy in deglutition to bring the child to the hospital but this was spontaneously re-

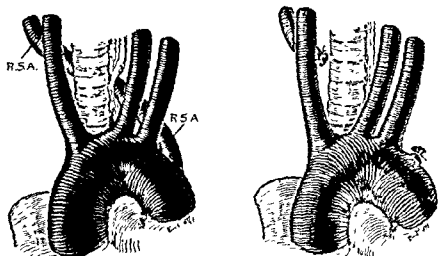


Fig. 5. a, left, Anomalous right subclavian artery, which arises from the left side of the aortic arch and presses on the posterior wall of the esophagus (Case 3) b, Method of surgical treatment for the dysphagia. The subclavian artery has been divided and esophageal pressure thereby relieved. R.S.A., right subclavian artery.

lieved during a few months' observation. In the sixth case there was persistent dysphagia which finally led to surgical exploration for its relief (Case 3 below). This abnormality is not necessarily one which will give its maximum symptoms in early life; there are observations to indicate that the dysphagia may first become manifest, or may be aggravated, in later years when the regional blood vessels become more rigid or become more dilated and thereby press more firmly on the esophagus.

It is now clear that the roentgenologists, by barium visualization of the esophagus, can detect this abnormality with great accuracy. Furthermore, it has been shown that it is possible completely to abolish dysphagia by severing the artery and removing it from behind the esophagus (16). A similar procedure could be carried out when the artery passes between the trachea and esophagus. In short, it is probable that this surgical procedure can be employed for a considerable number of persons who have difficulties—which might not endanger their life—but which are nevertheless quite disagreeable. We do not know of any descriptions of individuals with respiratory distress from a subclavian vessel which passes in front of the trachea. In the event of such an occurrence, division of the artery should be beneficial.

Fortunately, it is possible to divide the first portion of a subclavian artery without serious

impairment of blood flow to the arm. This is true because of the collateral vessels which communicate with the second and third portions of the artery and with the axillary artery. Interruption of the subclavian artery in its first portion will lead to a reduced blood pressure and a diminished flow in the extremity, but the remaining circulation is adequate to supply all of the important demands of the limb.

CASE 3<sup>1</sup>. J.R., a 4 month old infant, apparently had marked distress or pain while drinking his milk. This trouble began at about 1 month of age and had increased in severity since that time. The child would be quite hungry, would suck a little, and then would "straighten out with pain." After subsidence of this distress, a resumption of feeding would again bring on fretfulness and crying. There was occasional regurgitation of milk, but no projectile vomiting. At times the baby would take a full feeding, but usually it had to be limited to an ounce or two. It had become necessary to give the baby 15 to 20 small feedings per day to keep up the fluid and caloric requirements. The mother had to spend a major portion of her time in maintaining this schedule. The general physical examination was negative. The radial pulses were equal. Barium examination of the esophagus by Dr. E.H.D. Neuhauser showed a filling defect on the posterior wall of the esophagus which he believed to be characteristic of an anomalous right subclavian artery.

Under cyclopropane anesthesia, the superior mediastinum was explored through a left, transpleural, anterior wound. After a rather easy dissection, an arrangement of vessels was found as

<sup>1</sup> This case has been described elsewhere (15).

indicated in Figure 5a. The right subclavian artery was freed from its retroesophageal bed, the dissection being kept away from the thoracic duct. The vessel was then doubly ligated and divided. Its distal end was allowed to retract to the patient's right—beyond the esophagus (Fig. 5b). The chest was closed after re-expanding the left lung.

Following operation, the color and temperature of the two arms were always equal. Immediately after operation no right radial pulsation could be felt, but there was a faint beat in the right axillary artery. The right radial pulse could be felt on the fifth day. Since that time it has persisted but has been faint. Since operation there has been no hesitancy in swallowing. The child has been placed on a four hourly feeding regimen which is quite satisfactory. The baby was discharged on the tenth postoperative day. Since hospitalization there has been no evidence of dysphagia. Repeat barium examination of the esophagus shows it to be entirely normal.

#### PATENT DUCTUS ARTERIOSUS

The ductus arteriosus is a shunt between the aorta and pulmonary artery. This by-pass is essential during fetal life, but after birth it normally becomes obliterated and forms the ligamentum arteriosum. If the vessel should remain open the health or longevity of the individual might not be impaired, but such is not the case in most instances. The persistence of this shunt carries certain definite hazards: First, so much blood may be diverted from the peripheral circulation that the physical development is retarded. Second, the large amount of blood which is forced through this arteriovenous type of communication greatly increases the work of the heart and may lead to varying degrees of cardiac embarrassment or failure. Third, the abnormality may become a focus of infection, especially with the *Streptococcus viridans* organisms. The first hazard is one which will be manifest in childhood, the second and third complications rarely appear before adult life. While some individuals with an open ductus may have a reasonable span of life and little or no complications from it, there is ample evidence to show that in a series of patients the life expectancy is only a little more than half of normal.

In most cases a patent ductus arteriosus can be readily recognized. In infancy the physical findings may be confusing and in later life the presence of cardiac failure may

alter the picture somewhat. Except for these circumstances, the diagnosis can be made with great accuracy. There is no cyanosis, clubbing, or polycythemia. The murmur is one which should be rarely confused with the sounds of other cardiovascular defects. It is continuous, has a systolic accentuation, and usually has a rumbling or "machinery" quality. It is loudest in the second or third interspace to the left of the sternum, but it may be transmitted widely in whole or in part. In some instances, it is accompanied by a thrill, which is likewise maximal in the pulmonary area. There are certain features which are absent if the shunt is a small one, but are present if the leak is a large one. These are excessive forcefulness of the heart beat, a lowered diastolic blood pressure, and an increased amplitude of cardiac contraction by roentgenologic observation. The electrocardiograms commonly are normal; they never indicate a right axis preponderance, but occasionally they show some left axis deviation. In general, a patent ductus arteriosus can be recognized (or excluded) by a few minutes of intelligent use of a stethoscope. Laboratory and roentgenologic data may give confirmatory evidence and may be helpful in ruling out other lesions, but too much reliance should not be placed on these accessory aids if the auscultatory findings are not typical of an open ductus.

The indications for surgery are being broadened as more experience is gained with the operative treatment of this condition and as the mortality rate is being lowered to a reasonable figure. For the child or adolescent individual who has retardation of physical growth, closure of the shunt has had a profound effect in augmenting the peripheral blood flow and increasing the subsequent growth and weight of the patient. When there is cardiac embarrassment or failure, stoppage of the ductus leak greatly diminishes the work of the heart and provides a satisfactory cardiac reserve. In the presence of superimposed *Streptococcus viridans* infection, surgical closure of the ductus in 10 patients<sup>1</sup> was

<sup>1</sup>None of these patients had responded satisfactorily to sulfonamide therapy before operation, but these drugs were continued for variable periods after operation. In no case was penicillin given either before or after operation.

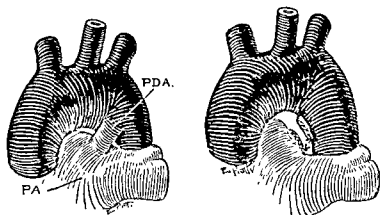


Fig. 6. a, left, Patent ductus arteriosus, forming a shunt between the aorta and pulmonary artery. b, Currently employed method of closure of the shunt. The ductus is completely divided, so that the pulmonary and aortic ends can be individually sutured. P.A., pulmonary artery; P.D.A., patent ductus arteriosus.

followed by no beneficial effects in 3 cases and by complete cure in the other 7. The technical difficulties of operation are considerable if the patient is beyond 20 to 25 years of age and especially so if there is superimposed cardiac failure or infection. For this reason we are convinced that it is advisable to undertake these operations in childhood before the regional vessels have developed a sclerosis which makes the handling of them hazardous. In a series of 130 treated patients, varying in age from 11 months to 47 years, there has been a surgical mortality in 5 instances—a fatality rate of 3.8 per cent. Excluding the adults of the series, there have been 90 operations with but one death—a rate of 1.1 per cent. Since the risks of operation have been kept at this low figure in the childhood group, it appears to be a sound policy to advise closure of the ductus in all young individuals, with the hope of avoiding serious complications in later life.

The method of closure of the ductus merits some discussion. Obviously, ligation of the vessel is the simplest procedure but it has drawbacks which are inherent in ligation of any vessel "in continuity." In a high percentage of cases, particularly in young patients and for the smaller shunts, simple ligation is quite satisfactory; but occasionally it gives a disappointing result. In 43 of our cases ligation was employed. In about 80 per cent of these the result was perfect, in about 10 per cent the ligature partially

cut through and some fistula was re-established, in about 10 per cent the ligature was not tied tightly enough to close off all of the shunt. This experience has led to development and adoption of a technique for complete division of the ductus which has now been carried out in 87 instances. The technique which is currently employed is essentially that, with only slight modifications, which has been previously described (15). In these 87 cases there have been 2 surgical fatalities. The first occurred on the operating table; the patient was a 26 year old woman who had been in cardiac failure and who succumbed shortly after the ductus had been divided and its ends closed. The second death occurred 2 weeks after operation from a staphylococcus mediastinitis. Experience with this operation makes it obvious that all of the shunt is completely shut off and that there is no chance for its re-establishment. While the technique may be difficult, the results obtained are so superior that we have completely abandoned the former operation of ligation.

CASE 4. D. E., a 14 year old boy, had some dyspnea on exertion but had never had frank signs of cardiac failure. He had had several prolonged periods when bed rest was advised. A heart murmur was known to be present since infancy. The boy was well developed and nourished. Blood pressure in the right arm was 116 systolic and 60 diastolic. There was a loud, machinery-like murmur, continuous but with systolic accentuation, which was most prominent in the pulmonary area. A promi-

nent systolic thrill was felt in the pulmonary region. Roentgenographic examination showed the transverse diameter of the heart to be slightly more than half of the internal diameter of the chest. The enlargement was particularly in the left ventricle. There was an increased amplitude of pulsation of the left border of the heart. There was an engorgement of the hilar vessels of the lungs. Electrocardiographic tracings were normal.

Operation was undertaken with cyclopropane anesthesia. The ductus was 7 to 8 millimeters in diameter and about 5 millimeters long. Four narrow clamps were applied to it and the vessel was severed between the two middle clamps. The proximal clamp on the pulmonary end was removed to provide a cuff which could be sutured with a running, fine silk stitch. The aortic end was likewise closed. The remaining hemostatic clamps were removed. The chest was closed and the lung was fully expanded.

There were no postoperative complications. The murmur has completely disappeared. The boy was discharged from the hospital on the 11th postoperative day. In the 6 months following operation, he grew 2 inches and gained 15 pounds. He developed an interest in sports and has no limitation of activities.

#### COARCTATION OF THE AORTA

Coarctation is a narrowing or complete occlusion of the aortic pathway. It has been found in the abdominal and in the lower thoracic portions of the aorta but in the vast majority of instances it is located in the distal segment of the aortic arch or in the uppermost part of the descending aorta, at or near the ductus arteriosus or its obliterated remnant, the ligamentum arteriosum. It has been stated to appear about once in 1500 routine autopsies. Two general forms have been described. In the *infantile* type there is a diffuse narrowing or obliteration of the distal part of the aortic arch so that there is an insufficient supply of blood to the left subclavian artery and possibly to the left common carotid artery. It is usually incompatible with life for more than a short period. In the *adult* type the narrowing is limited to a short segment and appears *beyond* the origin of the left subclavian artery so that it involves that part of the aorta which is joined to the ligamentum arteriosum (or the ductus arteriosus). The separation of cases into these two groups has no sound basis, since the underlying pathological or degenerative processes are probably the same in both. However, the

division does emphasize the fact that the "infantile" type is more extensive, is more prone to be associated with severe cardiac malformations, and leads to fatality in the first months of life, whereas the "adult" type is less apt to be associated with marked cardiac derangements and is compatible with a much longer existence.

The adult type of coarctation carries a variable prognosis. A small number of these individuals have attained old age and have had relatively little incapacitation, but the majority of subjects have developed serious or even fatal complications. The aorta may rupture because of the increased strain which is placed upon it and because of the sclerosis which can appear at an early age. An aneurysm, of a localized or a dissecting variety, may originate near the obstruction. The vascular abnormality may become the seat of superimposed infection, particularly with the *Streptococcus viridans* organisms. Finally, the blood pressure in the upper part of the body usually becomes elevated as a compensatory mechanism. It is not entirely clear whether this hypertension is a direct result of a mechanical blockage in the arterial pathway, or whether it rises from a diminished (or non-pulsating) blood flow to the kidneys. Elevated pressures may be tolerated for long periods of time, but it is obvious that they account for many fatalities on the basis of cardiac failure or central nervous system hemorrhage. Elevations in arterial pressure in the upper part of the body do not bear a direct relationship to the degree of aortic obstruction. The serious nature of coarctation of the aorta is indicated by Blackford's (2) study of 196 cases coming to autopsy; more than 40 per cent of these patients had died between the ages of 16 and 30 years of age.

Any intensive study of the problem leaves little doubt regarding the hazards which must be faced by most individuals who possess a coarctation of the aorta. It is therefore clear that surgical relief is highly desirable for these individuals—provided this can be obtained with a reasonably low mortality rate. Three general surgical approaches can be considered. First, an extensive sympathectomy will diminish the hypertension to

some extent, but how long these beneficial effects will last is still problematical. Second, the aortic obstruction can be by-passed by severing the left subclavian artery at the base of the neck and turning it downward so that it can be anastomosed to the aorta below the obstruction. Blalock and Park have suggested this method, after experimentation on animals, but its efficiency in man is doubtful because severance of the artery would cut off many important channels which invariably come from this vessel. Third, the obstruction may be removed from the aorta and the aortic continuity re-established by anastomosis of its free ends. The feasibility of such a procedure was demonstrated by the experimental work of Gross and Hufnagel (19). It was first performed in humans by Crafoord and it has been further established as a sound surgical procedure by our operative experience in 5 patients.

Coarctation of the aorta can be recognized by quite simple means, the important factor being the detection of an abnormal relationship in the pressures of the arms and legs. Normally, the systolic blood pressure is 20 to 40 millimeters of mercury higher in the legs than in the arms. Pressures of equal magnitudes in the arms and legs are suggestive of a mild aortic block, and lower pressures in the legs certainly indicate an important degree of obstruction in the aorta. Indeed, in most cases of coarctation the pressure in the legs is greatly reduced, and usually cannot be obtained at all with the sphygmomanometer. Palpation over the femoral and other major arteries of the legs shows a marked diminution in pulsation or a complete absence of arterial beats. Hypertension of variable degree may or may not exist in the arms. In children, the pressure in the arms may be relatively normal, but in older patients there is commonly a moderate or marked elevation of pressure in the upper part of the body. If collateral arterial channels have become well developed, and if the individual is not too fat, abnormal pulsations can be seen or felt over these accessory pathways, particularly along the intercostal arteries, over the axillary vessels, and in the regions medial and inferior to the scapulae. Murmurs are extremely variable,

and may be quite misleading. Undoubtedly, marked narrowing of the aorta produces a systolic murmur which can be heard over the left upper portion of the precordium and over the back, particularly to the left of the spine. But if the aortic block is complete there may be no murmur at all. Furthermore, the picture is often confused by the presence of associated cardiac defects such as a bicuspid aortic valve, an interventricular septal defect, or a patent ductus arteriosus, which give rise to audible sounds. Furthermore, large and tortuous collateral channels can initiate systolic or even continuous murmurs. It is therefore evident that a murmur *per se*, cannot be relied upon as an important criterion in making the diagnosis of coarctation of the aorta. Roentgenologic findings are such that they are a valuable aid in recognition of the vascular abnormality.

At first glance, direct surgical measures for excision of a constricted portion of the aorta would seem to be fraught with excessive dangers, yet this has not proved to be true in the limited experience which has been accumulated to date. The experimental findings of several observers have shown that in normal dogs the temporary obstruction (by clamping) of the upper thoracic aorta during operation will be followed in many instances by spinal cord degeneration and serious paralysis of the hind limbs. These observations should not be any deterrent to operation in human beings who have a coarctation of the aorta; under these circumstances there is little or no flow of blood through this segment of the aorta, the collateral channels are well developed, and the aorta can be clamped with impunity because this step will not materially diminish the supply of blood to the spinal cord during the period of aortic clamping. Hemorrhage from the aortic suture line might appear to be an insuperable problem, but this was not so in either of Crafoord's 2 cases, nor in any of our 5 patients. It is well to emphasize that the performance of an extremely accurate and careful anastomosis of the aortic ends completely eliminates the possibility of bleeding at the junction. Thrombosis at the site of anastomosis deserves some consideration, but in no instance has there been any evidence of

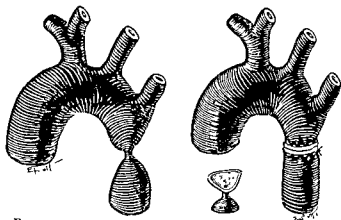


Fig. 7 a, left, Coarctation of the aorta, with a high degree of constriction and obstruction, just beyond the origin of the left subclavian artery b, Method of treatment, by excision of the narrowed segment and end-to-end suture of the aorta. Insert shows excised portion—possessing a very tiny lumen.

postoperative blockage of the aorta. Presumably, the establishment of an intima-to-intima anastomosis, combined with the rapid flow through the upper aorta serves to prevent any clotting in this region. It has not been necessary to give these patients anticoagulants during the postoperative period.

One pitfall which has appeared in these operations has been the marked readjustments which must be made in the circulation when the aortic anastomosis has been completed and the clamps are removed from the vessel. By this step, an enormous vascular bed is opened up in the lower part of the body, and the heart may not be able to cope with this strain if it is imposed upon it too quickly. In our first case, it led to an immediate fatality, but in all subsequent cases the clamp was taken off *slowly* (over a 5 to 10 minute period) and the adjustments were thus made in the cardiovascular apparatus in a very satisfactory manner.

The details of operative technique will not be discussed here. They have been presented fully elsewhere (17, 18, 19).

Postoperative studies on our 4 successful cases, and on the 2 which were reported by Crafoord and Nylin, show that there is a very satisfactory appearance of arterial pulsations in the legs and a concomitant fall of the pressure in the arms. The diminution of pressure in the upper part of the body does not take place abruptly—it occurs gradually during

the ensuing 10 days to 2 weeks. Presumably, the peripheral vascular bed (in the lower part of the body) is small before operation and a period of time is necessary to dilate it and thereby provide a large enough system to receive blood and relieve the congestion in the upper part of the body.

CASE 5. J.S., a 10 year old girl, complained of epistaxis of  $2\frac{1}{4}$  years' duration. The bleeding was sometimes copious. There were occasional headaches. Slight dyspnea appeared after light exercise. The child was well developed. The heart was slightly enlarged. There was a grade 2 systolic murmur to the left of the sternum, this could be heard with less intensity over the back. Blood pressures were: right arm, 152 systolic, 80 diastolic; left arm, 170 systolic, 110 diastolic. Legs, no beats heard. No pulsations could be felt over the femoral artery or other arteries of the legs. By roentgenographic examination the heart was somewhat full, but of a normal contour. Several ribs were notched along their inferior borders.

Operation was performed under cyclopropane anesthesia. Exposure was made through the left pleural cavity, posteriorly. A marked degree of aortic obstruction was found (Fig. 7a). A segment of aorta, about 6 centimeters long was mobilized, by dividing the ligamentum arteriosum, two bronchial arteries, and two sets of intercostal arteries. The narrowed portion of the aorta was removed, and the ends of the aorta were anastomosed by a continuous stitch which everted the ends (Fig. 7b). The excised specimen had a lumen which was narrowed to 2 millimeters in diameter.

The postoperative course was uncomplicated except for accumulation of fluid in the left pleural cavity which required one aspiration. Postoperatively, good pulsations can be felt in the legs, and

blood pressures are easily obtainable in the legs. The pressure in the arms gradually diminished over a 10 day period. Hospital discharge occurred on the 17th postoperative day. Blood pressures 1 month after operation were: right arm, 120 systolic, 80 diastolic. Right leg 150 systolic, 90 diastolic.

#### SUMMARY

A brief résumé is made of the more common abnormalities of the aortic arch and the large arteries which arise from it. Many of the anomalies do not give important symptoms, but others have considerable significance since they: (1) give rise to pressure on the esophagus and trachea; (2) impose a burden on the heart because of an arteriovenous type of shunt; or (3) lead to severe derangements in the circulation because of an obstruction in the aortic pathway.

In the first group of malformations under consideration, the esophagus or trachea (or both) are impinged upon by: (1) a right-sided aortic arch; (2) a double aortic arch; (3) a constricting ring of vessels (or remnants thereof); or (4) by an anomalous right subclavian artery. A right-sided aortic arch cannot be changed by surgical means, but if this abnormally placed structure is attached by a ligamentum arteriosum (or a patent ductus arteriosus) to the pulmonary artery so that this latter vessel is pulled back against the trachea or the left side of the esophagus—then division of the ligament (or the ductus) should give some relief. When a double (or split) aortic arch gives respiratory distress, the patient can be greatly helped by cutting the anterior (left) limb. When dysphagia lusoria occurs from a right subclavian artery (which originates from the left side of the aortic arch), the symptoms can be abolished by dividing the artery so that it no longer presses on the esophagus.

Humans with a patent ductus arteriosus are subject to certain hazards, particularly in mid-life. The shunt can greatly increase the work of the heart and lead to varying degrees of embarrassment or failure. Furthermore, the open ductus is frequently the seat of superimposed bacterial infection. While some individuals live a long and active life with a patent ductus arteriosus—particularly if it is a small one—statistics indicate that the

average length of life is little more than half of the normal expectancy. Surgical closure of the ductus has been shown to have very beneficial effects on the cardiovascular apparatus. While surgery can be deferred until symptoms have developed, the technical difficulties of operation at such times is considerable. In contrast, the closure of a ductus at an early age can be accomplished with a negligible risk, and hence we recommend operation in childhood or young adult life before complications have developed. A widening experience in this field makes us feel that ligation of a ductus is usually satisfactory, but that complete division of the vessel is a much superior procedure because it insures complete interruption of the shunt and precludes any possibility of its re-establishment.

Individuals with a high degree of obstruction in the distal part of the aortic arch or in the first part of the descending aorta may live to advanced ages with little or no difficulty, but most of them develop serious or even fatal complications in mid-life. Outstanding among the sequelae of coarctation of the aorta is hypertension which usually appears in the upper part of the body. With this increased pressure may come all of the disorders and dangers of the hypertensive state. Experimental observations show that a section of the upper thoracic aorta can be excised and that the open ends of the aorta can be satisfactorily joined. Such a procedure has been adapted to humans; a narrowed (or completely obstructed) segment of the aorta can be removed and the remaining ends of the aorta can be anastomosed. After performance of this operation, the hypertension is quickly relieved.

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# THROMBOPHLEBITIS OF THE DEEP VEINS IN THROMBOANGIITIS OBLITERANS

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**I**N spite of the fact that thromboangiitis obliterans is known to involve the peripheral great veins as well as the arteries, no cases of this condition have previously come to my attention in which deep thrombophlebitis was the outstanding clinical manifestation. This disease involves the arteries and veins segmentally in adjacent areas. Perivascular infiltration, progressing to fibrosis, later envelops the artery, vein, and accompanying nerve. Except for the occurrence of superficial migratory phlebitis, the clinical manifestation is most frequently one of arterial insufficiency, rather than that of venous obstruction. Homans says, "So far as the veins are concerned, thrombosis is coextensive with that in the arteries. Actually, venous thrombosis is entirely overshadowed by the arterial disease, and so solidly fixed that embolism never occurs. . . . From a clinical point of view, it is only the arterial disease which is of consequence." Collens states, "Deep venous thrombosis will occur, especially with extensive gangrene, but may be unrecognized until amputation is performed; it can then be seen at the site of amputation."

At this hospital 164 patients with thromboangiitis obliterans have been studied. Many of these soldiers were admitted with bizarre and atypical histories, and the diagnosis was established only after investigation of the vascular system. The following case reports of 2 soldiers whose first manifestations of this disease were in the nature of deep thrombophlebitis are examples. The onset was afebrile with no previous history of acute infection or trauma.

**CASE 1.** This 36 year old soldier of Polish (non-Jewish) parentage gave a history of fatigue and intermittent claudication of the calves of both legs, of insidious onset, for 10 years. He had had mild dyspnea on exertion and intermittent swelling of the left ankle for the previous 2 years. On October 13,

1943, while overseas, without history of injury or antecedent acute illness, he suffered the onset of pain in the left calf and thigh accompanied by swelling from the toes to the lower thigh. There was no chill nor elevation of temperature. He was put to bed with elevation of the limb and given sulfadiazine for 8 days. On November 6 he was permitted to hang the leg over the side of the bed and 5 days later was allowed to be up. Because of precordial pain, electrocardiograms were made on 3 successive weeks. These showed evidence pointing to myocardial infarction. Because of persistent swelling of the left lower extremity, he was again put to bed. With rest the swelling subsided. The patient was thought to have had thrombophlebitis of the left lower leg.

On January 7, 1944, the right lower extremity suddenly became painful and edematous. Roentgenograms were made for evidence of intra-abdominal tumor which was suspected as the cause of the spread of deep phlebitis from the left to the right lower extremity. These were normal. On February 7, 1944, while being studied under the fluoroscope, the patient suffered a sudden, severe pain in the left chest and later coughed up bright red blood. Roentgenograms the following day showed evidence of pulmonary infarction of the right lower lobe. He was put to bed for 3 weeks and when subjectively improved, was moved to the United States.

Upon arrival he was found to have excessive edema of both lower extremities from the toes to the inguinal regions. The heart and lungs were normal. On March 4, 1944, electrocardiograms again showed evidence pointing to an old myocardial infarct of the anterior wall of the heart. The following day bilateral common femoral vein ligation was performed under local anesthesia and segments of these veins were removed for study. Microscopic examination showed pronounced thickening of the walls, marked perivascular infiltration and occlusion of the lumina by organized thrombi. These thrombi contained only a few slit-like channels lined by endothelium, and containing blood. There was slight infiltration of the walls by small round cells and mononuclear leucocytes. Venograms showed the venous return of the left lower extremity to be by way of the lateral circumflex iliac vein. Following healing of the operative wounds, the patient was encouraged to walk about and was transferred to this hospital for further study and treatment on April 22, 1945.

On examination both lower extremities showed massive pitting edema from the toes to the groins (Fig. 1). During dependency there was rubor of both plantar surfaces and toes. There was no pallor on elevation and both feet were normal in color in the

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Fig. 1. Case 1. Massive pitting edema from toes to groins of both lower extremities.

horizontal position. There were no trophic changes and no sweating. The dorsalis pedis and posterior tibial pulses were feeble on the left and absent on the right side. The left popliteal pulse was normal, the right feeble. The radial and brachial pulses were equal and normal. Dorsiflexion of the foot (Homans' sign) was negative bilaterally. The dorsal surface of both feet were warm but both plantar surfaces and toes were excessively cold to touch.

TABLE I.—CASE 1. SPINAL ANESTHESIA  
VASOMOTOR TEST

	Oscillometry,			
	Control		After spinal	
	Right	Left	Right	Left
Popliteal	2 0-100 mm	5 0-100 mm	2 5-90 mm	5 0-100 mm.
Tibial	1 0-100 mm	2 5-100 mm	1 5-90 mm	4 0-90 mm
Foot	0 25-90 mm	0 5-90 mm	0 5-70 mm	2 5-80 mm
Skin Temperatures—Degrees F.				
1st toe	84	84	88	91
2nd toe	83	83 5	88	91
3rd toe	82	83 5	89	91
4th toe	82	83 5	89	91
5th toe	81 5	83 5	89	90 5
Plantar	84 5	85	90	91
Dorsum	87 5	87 5	90	90
Ankle	87	87 5	89 5	90
Midleg	89	89	89 5	90
Knee	86	87	87 5	90
Thigh	87	88	88 5	90

Room temperature, 78°F.

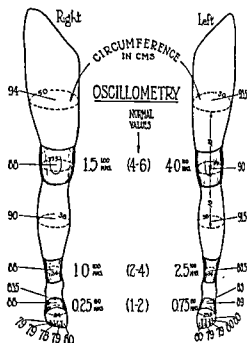


Fig. 2. Case 1. Skin surface temperatures in degrees Fahrenheit. See Table I.

Oscillometric readings were normal at all levels of the left lower extremity except for slight diminution in the foot. The readings of the right side showed a marked diminution at the popliteal, tibial, and foot levels in contrast to the corresponding levels of the opposite side. Circumferences of both lower extremities were symmetrically increased. Skin surface temperatures corresponding to the sites illustrated (Fig. 2) of both lower extremities were symmetrically and pathologically diminished in the toes and plantar surfaces of the feet.

Under spinal anesthesia, readings of skin surface temperature and oscillometry were done after complete motor and sensory anesthesia of both lower extremities was present. Similar readings were done, as controls, prior to the spinal anesthesia. The findings are recorded in Table I. These readings showed no increase in oscillometry with only a moderate rise in temperature on the right side but, on the left side, the oscillometry was normal under anesthesia and the skin surface temperatures reached 91 degrees F. This test showed the typical asymmetry usually found with advance organic vascular disease accompanied by secondary vasospasm. The involvement was confined to the right side. The left side was believed to be functional since the vasospasm was completely relieved during anesthesia. A diagnosis of thromboangiitis obliterans was made on the following findings.

1. Evidence of myocardial infarct in a 36 year old patient.
2. Intermittent claudication in both calves of 10 years' duration.



On dependency the dorsal and plantar surfaces of the left foot were cyanotic and the toes were ruborous. The right foot was ruborous from the midfoot to the toes. On elevation cadaveric pallor was observed on plantar surface of the right foot and toes. The left side was normal. The dorsalis pedis, posterior tibial, and popliteal pulses on the right side were absent. The left dorsalis pedis and posterior tibial pulses were feeble and the popliteal pulse was weak. Oscillometric readings on the right side were barely perceptible at the tibial and popliteal levels and zero at the foot. The readings on the left side were diminished at the popliteal level, tibial level and the foot. The skin surface temperatures were within normal limits on both sides but 2 to 3 degrees F. higher in the left toes than the right (Fig. 3). Comparative circumferences showed the right leg and ankle to be greater than the left.

Under spinal anesthesia, readings of skin surface temperature and oscillometry were done, after complete motor and sensory anesthesia was present. Control readings were recorded prior to the spinal injection. The findings are recorded in Table II. The test showed advanced obliterative vascular disease of the right femoral artery. The left side showed early obliterative arterial disease in the foot. Severe secondary vasospasm was found on both sides. These findings support a diagnosis of thromboangiitis obliterans involving the major arteries of right lower extremity and distal arteries of left foot.

On the basis of the criteria necessary for a diagnosis of thromboangiitis obliterans, this disease was established in the 2 cases reported. The importance of these case reports lies not in establishing a diagnosis of thromboangiitis obliterans alone, but also in recording the cardinal symptoms which brought about the hospitalization of these patients. Both patients gave a history of insidious and progressive arterial incapacity going over a period of time prior to the onset of the signs and symptoms which precipitated their hospitalization. In neither instance was the incapacity severe enough to excuse them from military service. However, the appearance of spontaneous, afebrile, deep thrombophlebitis without apparent systemic disease, infection, or trauma brought about their hospitalization.

In the first case, the patient suffered arterial involvement not only of his right lower extremity but also of his myocardium. The latter was evidenced by electrocardiographic changes. The deep thrombophlebitis was the factor that led to his hospitalization. The occurrence of pulmonary infarction, secondary to thrombophlebitis, caused by thromboan-

giitis obliterans, is rare, and therefore, is reported in this paper. Biopsy of the veins confirmed the diagnosis.

In the second case, the patient's peripheral vascular symptoms were obscure until involvement of the right femoral vein with clinical manifestations of deep thrombophlebitis appeared. Anesthesia in the skin of the right leg was severe enough to cause a third degree burn by a hot water bottle followed by secondary indolent ulcer. This is not uncommon in the ischemic limb. His treatment, at time of admission to hospital and thereafter, was chiefly concerned with the deep thrombophlebitis.

The diagnosis of thromboangiitis obliterans was made on the basis of the findings of diminished and asymmetrical oscillometric readings in the lower extremities; the presence of dependent rubor, and plantar pallor on elevation; absent unilateral pulses in the feet, and diminished skin temperatures. The persistence of abnormal oscillometry with increase of skin surface temperature in the feet after relaxation of the sympathetic nerves under spinal anesthesia implies the presence of organic vascular disease.

#### SUMMARY AND CONCLUSIONS

1. The signs and symptoms of deep thrombophlebitis may be present as a clinical symptom in thromboangiitis obliterans.
2. Pulmonary infarction may result from thrombosis of the great veins involved in the process.
3. Every case of afebrile idiopathic deep thrombophlebitis in a young patient must be considered a possible instance of thromboangiitis obliterans and the arterial tree carefully investigated for further vascular involvement.
4. The presence of passive congestion in a limb secondary to venous obstruction may cause a reactive hyperemia which temporarily may mask some of the signs and symptoms of arterial insufficiency.

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# RELATIVE SURGICAL CURABILITY OF CERTAIN GROSS TYPES OF GASTRIC CARCINOMA

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A STUDY of the general statistics presented in 239 cases of gastric carcinoma is the basis of this paper. The paper does not discuss the general curability of gastric carcinoma but deals solely with the relative curability of certain types of this disease.

The most beautiful synopsis of all aspects of the prognosis of gastric carcinoma is found in the admirable book of Livingstone and Pack. The analysis of their enormous material is profound and cannot be successfully attacked. It may be doubted, however, whether all conclusions arrived at by the authors are equally valid. I refer especially to two conclusions. The first one is the statement: "Gastric surgery does not now, nor is it likely in the future, to prove a satisfactory answer for more than the smallest number of patients." This statement is undoubtedly correct for the present time, but it is possible that better conditions may be hoped for in the future. Attempts at mass examinations of symptom free people have been made. Attempts also have been made to discover early and to observe precancerous conditions; the initial research possibly may not be too successful, but there is no reason to lose courage and to discontinue such attempts.

The second conclusion of Livingstone and Pack, the validity of which seems questionable, is the recommendation of resection in as many cases of gastric cancers as possible. This recommendation is given in spite of the pessimistic attitude mentioned. The patient with gastric carcinoma is lost if resection is not performed. Resection alone provides hope. Certainly, it is unjustifiable not to attack surgically the neoplasm in any patient who may be saved. However, in the long run, the recommendation of more and more indiscriminate resections is scarcely the best way to obtain

better results. The authors may have overlooked the fact that large numbers of resections will not only increase the number of surgical successes—cures—but will increase even more the number of surgical failures; as stated before, only a very small number of patients can be cured, so the number of surgical failures will grow overwhelmingly. These failures will discourage the laity, with the result that instead of early surgery being done more often, less and later surgery will be performed—a development to be prevented under any circumstance. Therefore, it is imperative to find ways by which, in a given case, a reasonable prognosis can be made before operation.

It is well known that the degree of malignancy in gastric carcinomas, as in other carcinomas, varies. Attempts have been made to express, by means of the microscopic grading of these tumors, the degree of malignancy and the surgical prognosis. Grading, by microscope, however, is not too reliable. It is true that grades 1 and 2 gastric carcinomas give a much better prognosis than do grades 3 and 4 tumors (3); but grades 3 and 4 carcinomas can be cured with rather great relative frequency. On the other hand, a certain number of grades 1 and 2 tumors prove to be very malignant clinically. Furthermore, microscopic grading cannot be accomplished before operation. Gastroscopic biopsy alone would make such grading possible. While this procedure at present does not yield satisfactory results, it may be developed later. Even then, the finding of a grade 3 or 4 carcinoma would not justify abandonment of surgery.

Another and perhaps better way would be to base the prognosis and the therapeutic procedure on *gross types* of gastric carcinoma. Borrmann has described 4 gross types; it was not his intention, however, to correlate the gross type with the prognosis. The classification presented is based only on gross appearance of the tumor (Schindler, 6; Bockus).

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Fig. 1. Carcinoma, type I. Resected specimen. A polypoid tumor protrudes into the lumen of the stomach. The tumor is sharply limited everywhere. Its edge is partly mushroom-like and overhanging. In this case its surface is ulcerated but ulceration is not the rule in type I carcinoma.

#### THE GROSS TYPES

Type I in this classification is the sharply limited polypoid tumor which projects hemispherically into the lumen of the stomach. It often looks like a mushroom with overhanging edges, its surface presenting numerous nodes and nodules which usually are of different sizes. Ulceration of the surface develops late. The mucosa surrounding this type of tumor is often thoroughly atrophic. Its incidence is about 2.9 per cent of all gastric carcinomas.

Type II is a sharply limited tumor also. It consists of an ulcer surrounded by an elevated wall. This wall has a steep slope toward the surrounding mucosa and is sharply demarcated all around. The floor sometimes shows necrotic material of various colors. The wall may be smooth, or more frequently it is nodular and contains shallow erosions. Its dark red color then is in marked contrast to the pale color of the surrounding mucosa. Its incidence is 17.6 per cent.

Type III is easily confused with type II. It also consists of an ulceration and of a wall. But the wall does not surround the whole circumference of the ulcer. The ulcer, sharply limited on one side, blends diffusely at some point with the neighboring mucosa which is diffusely infiltrated. Therefore, this is not a sharply limited but an infiltrative type of carcinoma. Its incidence is 16.3 per cent.

Type IV comprises the diffusely infiltrative tumors. No sharp limit is found anywhere; sometimes the entire stomach may be infiltrated. Within this infiltration ulceration may develop shallow or deep ulcers. The incidence of this type is 63.2 per cent.

It seems that a tumor of a given type never changes from this type however large it may become. A type II carcinoma remains sharply limited even if it finally involves the entire stomach; a type IV carcinoma is diffusely infiltrative when it is only a few millimeters in diameter. Still more remarkable is the fact that the microscopic structure of tumors of the same gross type may vary markedly. It might be expected that the microscopic structure would determine the gross growth, but this is not so. The sharply limited types I and II may be adenocarcinoma, colloid carcinoma, or medullary carcinoma, microscopically. The infiltrative types often are medullary or scirrhous carcinomas, but they may be colloid carcinomas or differentiated adenocarcinomas as well. What then causes the different types? The answer is not known. There are obviously two possible explanations: (1) that there are features of the microscopic structure responsible for the gross growth which we do not yet recognize; (2) that not the tumor itself, but the reaction of the surrounding tissue is responsible for the gross development of the tumor.

Early in my experience it seemed to me (6) that the prognosis in the sharply limited types I and II differed from that in the infiltrative types III and IV. In order to substantiate this belief care was taken to type as many as possible of the available cases of carcinoma, especially when resection had been carried out. Specimens obtained by resection of tissue usually make reliable typing possible. However, in a number of cases, pathological material could not be obtained, and the gastroscopic or x-ray evidence as to the type involved was not considered to be sufficiently accurate. Such cases were registered as "type not known."

From the previously mentioned incidence it will be seen that statistically the sharply limited types I and II constitute approximately 20 per cent of all cases of gastric car-



Fig. 2. Carcinoma, type II. Resected specimen. The tumor is rather small. A large ulcer is surrounded by a broad wall which is sharply limited at all points. There is no trace of infiltration. In some cases the wall may be thinner; it may even be partly absent. Characteristic is the sharp limitation of the lesion.



Fig. 3. Carcinoma, type III. Resected specimen. At the lower margin of the ulcer there is a very flat wall. In the right upper quadrant the carcinoma invades the gastric mucosa diffusely and the ulcer floor blends imperceptibly with the surroundings. In other cases the wall is much higher and better defined. Yet, if there is any infiltration instead of sharp limitation the tumor must be classified as type III.

cinoma; that the infiltrative types III and IV constitute 80 per cent of all cases. If the prognoses in these forms were approximately

equal, this ratio of 20:80 or 1:4 might well be expected to be found at any stage of the observation.





Fig. 4. Carcinoma, type IV. Postmortem specimen. There is diffuse infiltration along the lesser curvature with ulcer formation. Nowhere is any kind of limitation apparent.

#### ANALYSIS OF 107 RESECTED CASES

A total of 239 gastric carcinomas was analyzed. Surgery was done in 167, but only in 107 was resection for cure carried out (palliative resections are not contained in this figure). The data in these 107 resections form the basis of comparison of the types of gastric carcinoma.

Of 107 gastric carcinomas resected the gross type was not given in 20 but was known in 87 (see Table I). Eight belonged to type I, 22 to type II, 20 to type III, and 37 to type IV. In 40 cases the course was unknown; either no follow-up was possible or the follow-up did not last long enough. Thus there remain 67 cases, of which the course was known. Five belonged to type I, 12 to type II, 14 to type III, and 25 to type IV; but in 11 cases the type was unknown. In these 67 cases the follow-up was sufficient. But only the 56 cases with known types contribute to the final results of this study. Twenty-five of the 67 died postoperatively, and of these none belonged to type I, 5 to type II, 5 to type III, and 12 to type IV; in 3 the type was unknown. If again the unknown types are omitted, then there were 34 survivors of gastric resection with known course and known type: 5 belonged to type I, 7 to type II, 9 to type III, and 13 to type IV. (In Table I, one may also

find the "possible cures," which are obtained when the postoperative deaths are subtracted from the total number of resections.)

Table I also contains the statistics on surgical failures: those cases in which the death was actually observed and those cases in which recurrence was observed clinically and which usually were seen in the last stage of the disease. It will be noted that in all 8 cases of "unknown type" in which the course was known the patients succumbed; but one of them died from pneumonia, and as there was no autopsy it cannot be stated whether or not there was recurrence. The other 7 patients, however, died from recurrence. Of the 5 type I carcinomas, 2 died before the end of the 3d year. One of them died from heart disease after 2 years, 3 months; autopsy was performed and failed to reveal any sign of recurrence. The other type I case had had a polypsis *en nappe* (at gastroscopy 26 "single" adenocarcinomas were counted) and one of the polyps close to the cardia had developed into a sharply limited type I ulcerated carcinoma. The surgeon, believing that he was dealing with a benign tumor, made only a local excision. Half a year later the patient developed a carcinoma of the upper esophagus and succumbed quickly. Only 4 weeks before the death a successful gastroscopy was carried

TABLE I.—DISTRIBUTION OF GROSS TYPES IN 107 CASES OF RESECTED GASTRIC CARCINOMA

Gastric resections	Types				Unknown	Total
	I	II	III	IV		
Total cases	8	22	20	37	20	107
Course unknown	3	10	6	12	9	40
Course known	5	12	14	25	11	67
Postoperative deaths	0	5	5	12	3	25
Possible cures	8	17	15	25	17	82
Follow up in postoperative survivors	5	7	9	13	8	42
Failures						
{ Death observed	2"	2*	3	6	6†	19
{ Recurrence observed	0	2	6	6	2	16
3 year survivors†	(3)	(4)	(1)	(1)	(0)	
3 year cures	3	3	0	1	0	7
5 year cures	2	2	0	0	0	4

†The cases of 3 year cures are contained in line showing 3 year survivors, also; 2 of the survivors are found also among the recurrences.

"One patient died from heart disease—autopsy showed no recurrence. One patient died from carcinoma of the upper esophagus.

\*One patient died from coronary occlusion, 2½ years postoperatively; at autopsy no recurrence found.

†One patient died from pneumonia.

All other patients died from recurrence of the carcinoma.

out (in spite of the obstructing esophageal tumor), and no sign of recurrence was seen. No permission for autopsy could be obtained.

Of the 7 type II cases followed, 2 patients died before the end of the 3d year and in 2 others recurrence was observed. One of them lived longer than 3 years, however; this was a 3 year survivor, but not a 3 year cure. In 1 of the 2 cases in which the death was observed patient died from coronary occlusion after 2 years and 4 months. An autopsy was performed and no recurrence was present.

Of the 9 type III cases followed, all had recurrences of the carcinoma. One of them was a 3 year survivor. There was no observed cure.

In 6 of the type IV cases followed, death from recurrence was observed. In 6 others, the presence of recurrence was stated clinically. But 1 patient survived. He was seen alive and apparently healthy 3 years, 4 months after the operation.

If then we are to compare the types of the 7 remaining 3 year cures, we find that 3 of them belonged to type I, 3 to type II, none to type III, and 1 to type IV. If we combine the types I and II to the group of sharply limited carcinomas and types III and IV to the group of infiltrative tumors, then we should expect, as shown previously, that the ratio would be 1:4, if both groups would have equal chances

for cure. Instead, we find a ratio of 6:1. A patient having a sharply limited type of gastric carcinoma had a 24 times greater chance for a 3 year cure than a patient having an infiltrative type of tumor so far as these data are concerned.

Only 4 cures of 5 years' duration were known in this sampling of data but it is noticeable that all 4 of them belonged to the sharply limited group (type I-II), none to the infiltrative group!

In Table II attempt has been made to express the results obtained by percentage figures. Again, it should be borne in mind that an incidence ratio of 1:4 between the sharply limited and the infiltrative forms should be expected. The distribution of types in 87 cases of gastric resection in which the type was determined was as follows: 34.5 per cent of all cases belonged to types I-II, 65.5 per cent to types III-IV. The ratio, instead of the expected 1:4, is 1:1.9. Sharply limited tumors would appear to be resectable almost twice as often as the infiltrative tumors.

The ratio of postoperative deaths to the number of resections for the different types is also given in Table II; the postoperative mortality is 16.7 per cent for types I-II, but 29.8 per cent for types III-IV. Here a death ratio of 1:1 would be expected on the assumption of equal postoperative mortality. In

TABLE II.—PERCENTILE DISTRIBUTION OF GROSS TYPES OF GASTRIC CARCINOMA

	Type I	Type II	Type III	Type IV
Distribution of types in 87 cases in which the type was determined	8 = 9.2% 30	22 = 25.3% 34 5%	20 = 23% 57	37 = 42.5% 65 5%
Postoperative deaths	0 = 0% 5	5 = 11.7% 16.7%	5 = 25% 17	11 = 30.8% 29 8%
Known 3 year cures of all originally typed cases	3 = 37.5% (of 8) 6 (of 30)	3 = 13.6% (of 22) 20%	0 = 0% (of 10) 1 (of 57)	1 = 2.7% (of 37) 11%
1 year cures of all typed patients with known course	3 = 60% (of 5) 6 (of 17)	3 = 25% (of 12) 35 3%	0 = 0% (of 14) 1 (of 39)	1 = 4% (of 25) 2 8%
3 year cures of followed-up postoperative survivors	3 = 60% (of 5) 6 (of 12)	3 = 43% (of 7) 50%	0 = 0% (of 9) 1 (of 12)	1 = 17% (of 13) 4 5%
5 year cures of followed-up postoperative survivors	2 = 40% (of 5) 4 (of 12)	2 = 28.6% (of 7) 33 3%	0	0

stead we find the ratio to be 1:1.78. The relative postoperative mortality of the infiltrative types is 1.78 times higher than that of the sharply limited types.

Earlier in this paper, when the absolute figures were discussed, it was stated that the ratio of types I-II 3 year cures to types III-IV 3 year cures was found to be 6:1 instead of the expected 1:4. But for statistical purposes such a simple comparison seems scarcely permissible. The relation between the types at different stages of the observation varies, and it is perhaps fairer and more logical to relate the 3 year cures to the number of each type observed at the various stages. This attempt has been made in Table II. We may compare the 3 year survivors with all originally typed cases. There were originally 30 cases of types I and II and 57 cases of types III and IV. But of the 30 types I and II cases, 6 had a 3 year cure representing 20 per cent. Of the 57 types III and IV cases only 1, or 1.8 per cent, was a 3 year cure. These percentages 20:1.8 equal 11:1. Thus of all originally typed resected cases, a type I-II patient had an eleven times greater chance for a 3 year cure than did a type III-IV patient. It must be recalled that these ratios are based on relatively small samplings. The problem of the reliability of the findings is discussed in a statistical note appended to this paper.

We may choose to relate the final known 3 year cures to all typed patients with known

course (Table II). Here the postoperative mortality is included, and since it is higher in types III and IV than in types I and II, the results become still more unfavorable for the infiltrative types. In 17 type I-II patients and in 39 type III-IV patients the course was known. The 3 year cures in types I-II (6) constitute 35.3 per cent; those in types III-IV (1), only 2.6 per cent. The ratio is 13.5:1. Analyzing all typed patients with known course we find that types I-II patients have a 13.5 times greater chance of a 3 year cure than have types III-IV patients.

Finally it may be interesting to eliminate the postoperative deaths and to compare the final results with those postoperative survivors who had a sufficient follow-up. Twelve postoperative survivors of types I-II were followed up and 22 postoperative survivors of types III-IV. The 6 types I-II 3 year cures constitute 50 per cent, the one types III-IV 3 year cure constitutes 4.5 per cent of these survivors. The ratio is 11:1. If we analyze only the postoperative survivors, the types I-II patients still seem to have an eleven times greater chance of a 3 year cure than do the types III-IV patients.

Whichever of these comparisons is chosen, it becomes apparent that a patient having a sharply limited gastric carcinoma has a 10 to 13 times greater chance of a 3 year cure when resection is performed than has a patient with an infiltrative carcinoma.



I hope that the startling results may be a stimulus for the continuation of similar research. In my opinion, even single cases of long term cures are interesting, if the gross type can be stated beyond doubt. And we certainly are looking anxiously for the publication of 5 year cures in infiltrative forms of gastric carcinoma. Although 3 year apparent cures by no means prove a real cure (Nathanson and Welch), even the publication of several cases of 3 year cures in infiltrative forms would seem worthwhile because they would contrast sharply with the one case from these data.

It is not my impression that the average life duration of the patient with an infiltrative carcinoma is shorter than that of a patient with a sharply limited form, if no operation is performed. I have no statistical material to prove this point. Not rarely patients with diffusely infiltrative carcinomas are seen who live relatively long, about 3 years, not uncomfortably. On the other hand, sharply limited tumors, especially of type II, may be seen to grow rapidly and terminate the life of their bearers in a few months. All conclusions one wishes to draw from the materials presented can possibly refer only to the surgical prognosis.

If the results obtained here should prove correct in 10 years, then they would influence the treatment of gastric carcinoma greatly. Then obviously one should try to diagnose the favorable limited types of gastric carcinoma as early as possible, and one may become reluctant to attack infiltrative forms surgically unless the respective tumor is very small.

At present it is much too early to draw any conclusions; but the question may come up: how can we recognize the different types without exploratory laparotomy? Whichever method we may use we will be careful never to make the diagnosis of an unfavorable infiltrative type as long as there is still the remote possibility of a favorable limited type. However, by x-ray examinations diffuse infiltration can often be stated without ambiguity, and a wall surrounding the entire lesion sharply will often permit the diagnosis of a type II carcinoma. Relief technique is indispensable for such diagnoses (8). Often then the Car-

man meniscus sign will be found which is almost pathognomonic for the favorable type II, and only rarely will be seen in the unfavorable type III.

Gastroscoopically the types can be recognized often beautifully. Great care, however, should be exercised. The gastroscopist must not dare to diagnose the type, if he has not seen the entire circumference of the tumor. Schindler and Letendre (7) published reports of 74 cases in which gastroscopic typing was checked surgically. Three cases were believed to belong to type I; but one of them proved at surgery to be a type II carcinoma. Fifteen cases were believed to belong to type II at gastroscopy. This was correct in 14 cases, but 1 case proved to be an infiltrative type IV carcinoma. In 20 cases, a type III tumor was diagnosed. In 19 cases this diagnosis proved to be correct, but one case was found later to be a favorable type II. In 36 cases a diffusely infiltrative type IV carcinoma was diagnosed, but this diagnosis proved to be incorrect in no less than 7 cases. In 3 cases a type III carcinoma was found in the gross specimen. But in 4 cases a type II carcinoma proved to be present, and this mistake is obviously important. This experience led to the conclusion to be careful with the gastroscopic typing of gastric carcinoma. Generally it can be stated, however, that with combination of x-ray and gastroscopy a rather satisfactory typing of gastric carcinoma is possible before surgery.

#### SUMMARY

1. In 7 cases of gastric carcinoma a 3 year cure was observed, and in 4 of them a 5 year cure. Of the 7 observed 3 year cures, 6 belonged to the sharply limited gross types (types I-II) and only 1 to the infiltrative types (types III-IV). After 5 years only 4 patients having had a sharply limited carcinoma (types I-II) were known to be alive.

2. These data are too limited to permit any final conclusions, but the results of the analysis should stimulate further research about the incidence of the gross types of gastric carcinoma among the long term postoperative survivors.

3. By combination of x-ray and gastroscopy usually the gross type of a gastric

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# MANAGEMENT OF PLASTIC MAXILLOFACIAL WOUNDS IN AN EVACUATION HOSPITAL

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THIS report is based on the case records of 1148 patients treated by a plastic maxillofacial team during approximately one year's work in a 400 bed evacuation hospital where the incidence of plastic maxillofacial injuries was 7.1 per cent. All of these patients, except 79 burn cases, received an anesthetic. Of the patients under consideration, 770 had only maxillofacial wounds but the remainder, or 32.2 per cent, had both maxillofacial and other injuries which were also operated on by the team. A total of 2,350 operative procedures were performed upon the reported group: 1,927 plastic maxillofacial and 423 additional operations.

## GENERAL CONSIDERATIONS

On each successive opening of the hospital this team represented the most forward maxillofacial personnel. Therefore more than 90 per cent of the patients were seen within 20 hours after injury. The peak load always occurred during the first few days of each set up. Since immediate treatment was an urgent necessity, it seems worth while to review salient features in the plan used in caring for the injured, preliminary to surgery.

*Preliminary care.* First, it was found most advantageous for the plastic maxillofacial team to do the triage on patients with plastic maxillofacial injuries. This procedure (1) permitted a continuous flow of patients to the operating table, alternating the severely injured with the less severely injured so that the time necessary for the preparation and anesthetizing of the former could be utilized in the treatment, under local anesthesia, of the latter; (2) established priority of cases for surgery; (3) took cognizance of patients in shock from anoxia and requiring establishment of an open airway before they could become surgical risks; and (4) permitted

recognition of those cases in which pressure dressings did not control hemorrhage.

Second, to eliminate unnecessary handling, patients were sent to x-ray tent, returned to preoperative or shock tent, and later taken to surgery without being removed from their litters. During times of peak load no baths were given before patients reached the operating tent, since exposure in an improperly heated tent would only increase their discomfort and hazard.

Preoperative medication and therapy were administered by preoperative or shock personnel after the patient had been seen by a member of the plastic maxillofacial team. Atropine, grains 1/150 to 1/100, was given to every patient. Morphine was or was not given, depending on the amount administered by forward medical units. As has been pointed out by others, mere lack of signs of morphine effect is no criterion for the administration of more of the drug, since absorption may have been delayed. A patient who is in more or less shock and exposed to the cold may show no signs of morphinism for as long as 9 hours after subcutaneous administration of 1/2 grain of morphine.

Careful attention to the state of the patient determined whether or not blood, plasma, or crystalloid fluids should be used. One death (see Case 1 under "Deaths and Their Causes") can probably be attributed to the lack of such supportive treatment.

Third, in the operating tent we preferred to use a master instrument table with two operating tables, thereby reducing waste in sterile instruments and consequently saving time.

Fourth, we found compelling reasons for using a general anesthetic in the majority of cases. It was impossible to give these patients adequate surgical preparation under local anesthesia, for the wounds were filled with

caked sulfanilamide powder, dirt, and dried blood so that it was necessary to scrub the area with white soap and liberal quantities of water and to irrigate the wounds with sterile saline solution. The high percentage of patients who had multiple injuries requiring surgical treatment presented another objection to the use of local anesthesia.

After the patient was surgically prepared and draped, examination was completed and the findings correlated with the roentgenograms to permit a planned operation.

*Surgical care.* Careful and adequate débridement was our rule. "Débridement," as used in this paper, comprehends the removal of all devitalized tissue, detached bone, and foreign material, including missiles. Aided by adequate roentgenological localization we were able to remove all foreign bodies in almost every instance. Such removal could be accomplished with greater ease and profit at this stage than at a later operation, because the wounds were already open and exposed to their depths for excision, and the paths of the missiles were still unabridged.

In our hands, primary closure of battle wounds of the face and neck was consistently achieved if operation were performed within 20 hours after injury. Seldom were we confronted with a patient seen too late for the successful performance of primary definitive surgery, other than reconstructive. Since it was a policy to evacuate none except the slightly injured under a minimum of 5 days postoperatively, and since some patients who presented special problems were held as long as 10 days, it is possible to speak with some degree of accuracy regarding the incidence of postoperative infection: superficial or stitch infection occurred in less than 5 per cent of the patients; no cases of cellulitis developed in the reported series.

Primary removal of foreign bodies was responsible, in great measure, for this low incidence of postoperative infection. Observations made here point to the conclusion that nowhere else does careful, adequate, and early débridement pay better dividends than in plastic maxillofacial surgery. In contrast, those who reached the general hospital without receiving definitive treatment at a more

TABLE I.—CAUSATIVE AGENTS

	Cases	Total
Gunshot wounds		
Rifle.....	147	
Machine gun.....	24	
Pistol.....	11	182
Shell wounds		
High explosive.....	626	
Mortar.....	26	652
Bomb wounds		
Aerial.....	19	
Grenade.....	9	
Mine.....	87	115
Nonbattle casualties.....	91	91
Burns		
Petrol.....	61	
Flash.....	40	
Phosphorus.....	7	108
Total.....		1148

forward installation had, by the time of their admission, such a degree of infection that a prolonged period of treatment was necessary. This resulted in not only an extended period of hospitalization, but, more important, in definite scar formation and contracture as well. It became evident that maxillofacial injuries should receive the benefit of definitive surgery done at the most forward element possible.

## WOUNDS TREATED

*Soft tissues of the face.* It would be difficult to exclude from this discussion the treatment of skeletal injuries to the face, because trauma of the supportive skeletal structure accompanies all except simple lacerations and abrasions in this area. Fractures with displacement need to be reduced and supported. If that can be accomplished, then accompanying injuries of the soft tissues can be treated as if the skeletal structure were undamaged. In many instances repair of the soft tissues gives adequate support to the fracture. When the fracture is reduced and the tissues sutured in their normal relationship an important step in the prevention of infection has been achieved.

Our usual procedure was as follows: The patient was given endotracheal ether with Flagg apparatus. The face was scrubbed with white soap and water and then shaved, though if the eyebrow were involved that area was prepared by clipping so that the normal hairline might serve as a guide in



TABLE II.—WOUND TYPE  
(ARMY CLASSIFICATION)\*

	Cases
Penetrating . . . . .	512
Perforating . . . . .	212
Lacerating . . . . .	184
Burns . . . . .	108
Blast (or tattoo) . . . . .	96
Gutter . . . . .	36
Total . . . . .	1148

\*In cases with multiple wounds only the major wound is listed.

approximating skin edges. The face was then scrubbed again with white soap and water, dried with sterile towels, and draped. Careful débridement was accomplished. The wound was irrigated with sterile saline solution. Fractures were reduced. If the maxillary sinuses were involved a nasal antrotomy was done, followed by packing with vaseline gauze. Frequently packing served the further purpose of supporting a fractured zygomatic malar. Hemostasis was meticulously effected. The deeper structures were approximated in their normal relationship with interrupted No. 0000 catgut or silk sutures, obviating all dead space. Skin margins were approximated with vertical mattress sutures of nylon or silk.

The question of tissue loss is an interesting one. There is no war wound of the face in which tissue loss is not represented, though it reaches its maximum in the avulsive type of injury. However, the degree of loss nearly always seems greater than it actually is. Often in reconstructing a severely injured face one is surprised to find almost all of the soft tissue present. The defect appears greater because of the distortion.

**Blast or tattoo injuries.** Multiple foreign bodies, powder, tar, gravel, dirt, and small bits of metal imbedded in the skin and subcutaneous tissues as the result of a nearby explosion of land mine, bomb, or shell were among the tattoo injuries. Surgical care of such injuries was tedious and time consuming. While the patient was under anesthesia, the area was thoroughly scrubbed with a stiff brush, soap and water, and then cleansed with ether as a solvent for tar and grease. All residual particles and fragments were carefully picked out with a curette or the point of an abscess knife.

**Enucleations.** This plastic maxillofacial team performed 51 enucleations, but only in those cases in which penetrating or perforating wounds of the eye were associated with collapse of the globe, as all other injuries of the eye were cared for by the ophthalmologist. When dealing with a badly mutilated eye we were careful to remove all retinal tissue, to prevent sympathetic ophthalmitis.

**Eyelids.** Of the 69 injuries to upper and lower eyelids, 17 were of such severity as to require reconstructive surgery. Treatment in the latter group consisted of (1) thorough cleansing of the wound, (2) protection of the cornea, and (3) early evacuation.

The remainder of these injuries were primarily sutured. Wounds that extended through the whole thickness of the lid were closed in two layers. The sutures of the conjunctival layer were brought out in the conjunctival sac and the edges of the cutaneous layer were loosely approximated, the sutures being tied on the surface. Due care was exercised to approximate accurately the borders of the lid.

**External ear.** We operated on 56 patients who had injuries of the external ear. Of this group 20 represented varying degrees of tissue loss and 2 patients had complete avulsion. Where the loss of tissue was not too great we effected reconstruction and primary closure. We débrided and excised to the point where accurate approximation of the wound margins was possible and then held the margins in place with interrupted nylon sutures supported by folded gauze and pressure dressing. Lacerations extending into the external auditory canal required careful suturing so that healing by granulation and eventual contraction might be avoided. When the loss of tissue was so great as to preclude primary repair we felt it mandatory to cover residual cartilage.

**Lips.** Of the 59 injuries to the lips which required operation, 15 were defects which could not be closed, including 9 which represented loss of one or both commissures. Where tissue loss occurred, all portions of the wound adjacent to the area of loss were closed, and in the resulting defect mucous membrane was sutured to skin.

*Nose.* Seventy-seven patients with injury to the soft tissues of the nose were treated. Fourteen of these represented a degree of tissue loss which precluded primary suture. Those injuries which extended through the full thickness of the ala were closed in two layers, due care being used in the approximation of the borders.

*Tongue and floor of the mouth.* We operated on 43 injuries of the tongue. Nineteen of these involved the floor of the mouth. In treating wounds of this area meticulous débridement and total hemostasis were accomplished. Mucous membrane in the floor of the mouth was carefully closed to prevent contracture. The tongue was closed in layers to obviate all dead space. Wherever there was loss of tongue tissue, débridement and closure were carried out in such a manner that one half of the tongue was not appreciably longer than the other.

*Accessory paranasal sinuses.* Surgical treatment was given to 171 patients with injury to one or more of the paranasal sinuses. In many instances roentgenological examination revealed the presence of a foreign body in the sinus. This we endeavored to remove whenever possible, believing that its continued presence must certainly result in infection.

We treated 115 injuries to one or both of the maxillary sinuses. In each instance nasal antrotomy was done and vaseline gauze drain installed through the antrotomy opening. It was also necessary to do a Caldwell-Luc operation on 11 of these patients in order to remove foreign bodies.

The anterior wall of the frontal sinus was involved in 16 cases. Treatment consisted of débridement and closure with rubber tissue drain. An effort was always made to preserve the superciliary ridge. If the posterior wall of the frontal sinus were injured the case was referred to the neurosurgeon.

Three injuries which involved both the ethmoidal and sphenoidal sinuses were seen. In one of these patients spinal fluid was draining from the left nares. In that instance the entrance wound was sparingly débrided, the loose bone fragments were removed, and the wound of entrance carefully closed. Nasal drainage was adequate. Due to the frequency

with which such injuries involve the meninges, both extensive débridement and search for a foreign body must be avoided.

## FRACTURES

*Nasal bones.* Seventy-six fractures of the nasal bones were reduced. Since the majority of patients in this group had multiple associated injuries which received simultaneous attention, endotracheal anesthesia was preferred. Asch forceps were used to manipulate the bones into realignment. The nasal septum was straightened and an attempt was made to return it to its groove in the vomer, but because of associated fractures this last step was not possible in every instance. Dressing consisted of dental molding compound over gauze, held in position by strapping with adhesive tape. It was necessary in 5 instances to evacuate a collection of blood from the septum. This evacuation was accomplished by means of an incision extending through the mucoperiosteum parallel to the floor of the nose.

*Mandible.* Of the 136 fractures of the mandible treated, 20 had lost so much bone tissue that continuity of the mandible could not be re-established. It was our policy to remove all primary and secondary foreign bodies, completely detached fragments of bone, loose teeth, and roots which were in the fracture line. Due care was exercised to remove no bone with periosteal or soft tissue attachments.

We found the anatomical classification of fractures useful only occasionally, as descriptive terms are of small benefit when methods of immobilization are being considered. When teeth remained, an all important consideration was immobilization of the mandible with the teeth in normal occlusion. Our method of choice was to attach the adapted half-round nickel silver labial arch bar to each arch separately with No. 18 gauge stainless steel wire, and subsequently to establish elastic intermaxillary traction. The latter was delayed until the postoperative period of nausea was passed.

Fractures associated with bone and tissue loss were supported in the same manner if sufficient teeth remained on both sides to give

TABLE III.—INJURIES OF BONES OF FACE

	Cases	Total
Mandible		
Fracture of body		
Unilateral	33	
Bilateral	11	44
(11 with severe loss of bone)		
Fracture of symphysis	39	39
(9 with severe loss of bone)		
Fracture of ramus	30	30
Fracture of condyle	12	12
(3 involved temporomandibular joint)		
Alveolar fracture alone	11	11
Total.		136
Maxilla		
Alveolar fracture alone	37	
(19 had extensive loss of teeth)		
Unilateral fractures	38	
(8 had extensive loss of bone)		
Bilateral horizontal fractures	19	
(5 had extensive loss of bone)		
Total.		94
Zygoma		93
(19 with loss of bone)		
Nasal		76
(27 with loss of bone)		
Multiple associated fractures		128

adequate stability to the arch and still maintain the proper occlusal relation of the teeth, as well as the proper spacing of the bone fragments. The maintenance of such relationship and spacing we considered of paramount importance, for failure in these respects would unnecessarily complicate reconstructive work at a later date. We found it possible to stabilize adequately even multiple comminuted fractures of the mandible by means of the arch bar and intermaxillary traction, provided a sufficient number of teeth remained.

The edentulous mouth presented a more serious problem. There the fracture was supported by circumferential wiring. This was accomplished by selecting the proper fitting dental tray, adapting softened dental compound to the repositioned mandible, and wiring around the tray in three or more places so that the lower jaw might be firmly secured and immobilized. Again No. 18 gauge stainless steel wire was the ligature of choice.

Only once, and then with an avulsion complete except for the left condyle and ramus, did we find it necessary to use extraoral fixation on the mandible. In that instance we stabilized with fixation from skullcap to

angle and lower border of ramus, with the hope of maintaining a functional left temporomandibular joint for future grafting and prosthesis.

Associated simple fractures of the alveolar process were invariably accompanied by loss of teeth. If the roots were not involved we attempted reduction and splinting, again securing stabilization by fixation to the remaining teeth with the half-round arch bar and stainless steel ligatures.

Dependent drainage was established by rubber tissue drain in all compound comminuted fractures of the mandible.

*Maxilla.* Ninety-four fractures of the maxilla were treated. In this series multiple associated fractures of the different bones of the face were common. In 13 cases the injuries were such as to cause extensive loss of bone.

Fixation, the type chosen depending upon the nature of the fracture, was of utmost importance both for control of hemorrhage and for maintenance of an adequate airway.

Fractures of the alveolar process alone were treated the same as were those of the mandible. Often we found that the unilateral horizontal fracture could be maintained in place by the use of an arch bar attached to the adjacent normal maxilla and firmly ligated.

The bilateral horizontal fracture of the maxilla presented the most difficult problem because of the downward and backward or the downward and forward displacement. Here again we attached the labial arch bar to the teeth in the maxilla, applied the plaster skullcap, and supported the floating segment of the maxilla with stainless steel wire passed through the soft tissues, over the zygoma, and attached to the arch bar in either of two locations: in downward and forward displacement the area of the first bicuspid was that of choice; in the backward displacement the area of the first molar was preferred.

When lacerations of the commissures of the mouth were present we avoided use of the Kingsley splint and similar appliances, as such devices tended to separate the wound edges and to cause a breakdown of our primary closure.

If both maxilla and mandible were fractured we did not hesitate to use elastic traction along with fixation to a plaster cap. This procedure eliminated the ineffective Barton's bandage, which we felt had no place in plastic maxillofacial surgery in an evacuation hospital.

**Zygomatic malar.** Fracture of the zygomatic malar was recorded in 93 patients, 19 with severe loss of bone. These fractures were usually associated with other fractures of the facial bones and, except in those cases in which the zygomatic bone alone was injured, the maxillary sinus was also involved. Entrance or exit wounds were invariably adequate for the employment of elevators. These, in conjunction with suitable tenaculum forceps for grasping the bone, were the mechanical aids necessary for reduction. After reduction was accomplished, in many instances accurate apposition and suture of soft tissues furnished adequate stabilization. Packing of the maxillary sinus with vaseline gauze through an antrotomy wound also gave support. In a few cases direct wiring or external traction with a skullcap was necessary.

**Mastoid.** We operated on 14 patients with compound fracture of the mastoid process. Operation consisted of débridement and removal of the air cells, introduction of sulfanilamide and penicillin powders, closure of the wound, and installation of a vaseline gauze drain.

**Multiple associated fractures.** One hundred and twenty-eight multiple associated facial fractures were recorded. These included fractures of the palate, ethmoid, vomer, turbinate, and lacrimal bones and will not be discussed individually.

#### OPERATIONS ON THE NECK

It is unnecessary to comment at length on either superficial or deep wounds of the neck which did not involve vital structures; there were 251 patients in this category. Débridement of the wound, with great care to remove all foreign and devitalized material, was routine in these cases. Whenever possible before final closure of extensive wounds the patient was allowed to cough or strain in order to make certain that hemostasis was complete.

**Tracheotomy.** Tracheotomy was performed 37 times. All tracheotomies were done under local anesthesia.

The low collar incision was used in preference to the vertical incision described in textbooks. The ribbon muscles were divided in the midline and the third and fourth tracheal rings were identified. A vertical incision was made through those two rings, a small segment of each ring was removed, and the tracheotomy tube was inserted. Bleeding was controlled and the wound was closed with interrupted silk sutures. Requiring tracheotomy were 15 perforating wounds of the larynx, 11 perforating wounds of the pharynx, 7 avulsive wounds of the mandible with severe injury to tongue and floor of mouth, 2 perforating wounds of the trachea, and 2 perforating wounds of both trachea and esophagus.

**Wounds of the larynx.** Seventeen patients with perforating wounds of the larynx, resulting from penetrating or perforating wounds of the neck, were cared for by our team. Of this series, 15 were operated on. The 2 patients on whom we did not operate require some explanation. One, a German civilian, had received a perforating wound resulting in the loss of the anterior portion of the thyroid cartilage. Through this wound a tracheotomy tube had been inserted at a field hospital. On admission to our installation the patient had pneumonia with a temperature of 103 degrees F. He died 36 hours later. The second patient, an American soldier who was admitted to the hospital with marked emphysema over neck and chest and in a state of severe shock, died a few hours after admission.

Of the 15 operable patients, 12 had perforating wounds of the thyroid cartilage and 3 had perforations of the cricoid. They presented varying degrees of emphysema and respiratory obstruction. Tracheotomy was performed under local anesthesia in all cases. This was followed by exposure of the entrance and exit wounds of the larynx through a collar incision at the level of the wound of entrance. The wound was débrided and hemorrhage was controlled; fragments of the cartilage were repositioned and held in place

by careful suture of the surrounding tissue. The wound was then repaired by primary suture.

**Pharynx.** Twenty patients with perforations of the pharynx were treated. These wounds were carefully debrided and closed in layers. Since we were very anxious to obtain primary healing of the mucous membrane, a soft rubber tissue drain was placed through the side of the neck only up to the suture line in the mucous membrane. The drain was removed on the second postoperative day. In several instances the entrance or exit wound was posterior to the sternocleidomastoid muscle. These injuries were handled in the same manner, except that the drain was placed in the posterior pharyngeal or lateral space and the wound was closed. All wounds in this series healed by primary intention.

#### ESOPHAGUS

Four perforating wounds of the cervical esophagus were seen and may be classified as follows:

1. Anteroposterior wound of the neck, perforating larynx and esophagus (Case 1).
2. Anteroposterior wound penetrating trachea and esophagus (Cases 2 and 3).
3. Transverse penetrating wound of the neck (Case 4).

**CASE 1.** The missile perforated the larynx at the level of the middle cricothyroid ligament, thence through the esophagus, coming to rest in the muscles of the posterior neck.

Tracheotomy was done under local anesthesia. The patient was then given a general anesthetic consisting of pentothal sodium with nitrous oxide and oxygen. The neck was opened with an incision extending from the wound of entrance to the tip of the left mastoid process; this was connected with a vertical incision along the anterior border of the sternocleidomastoid muscle, permitting the development of anterior and posterior flaps. The sternocleidomastoid muscle was divided transversely. The left superior thyroid vessels were identified and divided, permitting the left lobe of the thyroid to be retracted downward and mesially. The cervical portion of the esophagus was mobilized and the entrance and exit wounds were closed by pursestring sutures of silk, reinforced by mattress sutures. A Penrose drain was inserted into the posterior esophageal space and the wound closed. The laryngeal wound was closed by suturing adjacent tissue over it. Foreign body was not removed.

This patient was given nothing by mouth for the first 72 hours. During that time fluid and protein balance and sulfanilamide level were maintained by intravenous injections. After 72 hours the patient was given liquids, and starting on the fifth day he was given a soft diet. The Penrose drain was removed at the end of the first 48 hours; tracheotomy tube and suture were removed at the end of the fifth postoperative day. Primary healing of the wound had resulted. The patient was permitted out of bed on the seventh postoperative day and was evacuated the following day.

**CASE 2.** This patient presented an anteroposterior wound perforating both the trachea and the esophagus. He was treated in exactly the manner described in Case 1, and made an uneventful recovery.

**CASE 3.** This man also had an anteroposterior wound which perforated both trachea and esophagus. He died from anoxia resulting from a large blood clot which formed a complete bronchial cast. Had tracheotomy been performed and suction instituted earlier in the chain of evacuation, we believe this patient would have had a better opportunity to live.

**CASE 4.** A German civilian who was transferred to our hospital after operation in another installation had a transverse wound of the neck which perforated the cervical esophagus. The portal of entry was in the left inferior posterior triangle of the neck; the exit was through the right sternocleidomastoid muscle corresponding to the lower border of the thyroid cartilage. Operation consisted of debridement and carrying the dissection of the exit wound to the posterior esophageal space, leaving the latter open with a light packing to produce an esophageal fistula. Cervical cellulitis and mediastinitis had developed, accompanied by an elevation of temperature ranging from 101 to 104 degrees F. Sulfanilamide and penicillin therapy was instituted, together with supportive treatment with blood and plasma. It was possible to pass a Levin tube for feeding. This patient was evacuated to a civilian hospital, so no follow-up was possible.

In all 4 instances of wounds of the esophagus one symptom was outstanding—painful deglutition. This symptom was far more severe in wounds of the esophagus than in wounds of either the larynx or the pharynx. The presence of such a symptom, together with consideration of the course of the missile, determined the diagnosis.

#### VASCULAR INJURIES

**External carotid.** Patients who required ligation of one of the external carotid arteries were those who had received either avulsive wounds of the mandible or serious injuries in

the region of the temperomandibular joint, with division of the internal maxillary artery.

Early in the campaign a patient was brought in 1 hour after being hit by an 80 millimeter shell which produced a severe avulsion of the mandible. Hemorrhage was so severe that tracheotomy had to be performed with patient in the prone position. When we turned the patient over, the amount of macerated tissue made it impossible to determine which side was primarily responsible for the bleeding.

Under local anesthesia the right external carotid artery was exposed and compressed. This failed to control hemorrhage. The left external carotid artery was then exposed and observed to be much smaller in caliber than the right. When the smaller vessel was ligated hemorrhage was promptly controlled. This experience led us to believe that serious injury to one of two terminal branches of the external carotid produces vasospasm of the artery. Recognition of the vessel in spasm may be a useful diagnostic aid in deciding whether the right or the left external carotid artery is accountable for the major portion of the hemorrhage in avulsive injuries of the face.

*Lingual artery.* Frequently we were able to control hemorrhage from the tongue by suture ligation in the tongue itself. However, we found such treatment ineffective in 5 instances. Those patients required exposure and ligation of the lingual artery in the submaxillary space.

*Internal jugular vein.* Three patients with division of the internal jugular vein were seen. Whenever the path of a missile suggested injury to the contents of the carotid sheath and a hematoma of the neck was observed, a planned operation was instituted, with adequate exposure of the sheath above and below the injury. Then when the clot was dislodged, accidentally or intentionally, the resultant hemorrhage could be quickly controlled.

*Common carotid artery.* Two patients with injury to the left common carotid artery were admitted. The first was seen 18 hours after injury. At this time hemiplegia already existed, with marked restlessness, confusion, irritability, and total lack of co-operation. Proximal and distal ends of the vessel were ligated. The patient died on the third post-operative day.

The second patient was admitted 16 hours after injury, and, as with the first patient, hemiplegia had already developed. This patient was not operated on. He died the second day after admission.

#### ANESTHESIA

Anesthesia for the seriously wounded maxillofacial case is not always ideal in an evacuation hospital, due to sudden waves of patients with resultant shortage of anesthetists and anesthetic equipment. Discussion among surgeon, oral surgeon, and anesthetist almost always leads to the choice of an anesthetic that is satisfactory to all. Two factors make this anesthetic problem different from that in surgery of the trunk or the extremities. First, it may be difficult, if not impossible, to maintain an adequate airway before, during, and after operation. Second, the anesthetist and his paraphernalia must not interfere with the surgeon. In our experience, frequently the former and sometimes both factors necessitated tracheotomy before a general anesthetic was begun; and it was soon determined that the extensively or seriously wounded patient could best be cared for under general anesthesia.

Every patient who received ether was inducted rapidly to avoid the vomiting, straining, and struggling which would almost certainly result in active bleeding. Even so, suction had to be used in most cases, either during induction or just before insertion of the endotracheal tube.

The endotracheal route was generally used in the administration of ether, but whether nasal or oral depended on the nature of the injuries and on the procedure contemplated.

For example, a patient requiring the placing of labial arch bars and other intraoral procedures was handled with the nasal tube. The largest possible tube (up to and including size No. 38 F.) was used to facilitate the passage of a large urethral catheter so that aspiration of the trachea might be accomplished through the same channel. This latter procedure was necessary because many patients had aspirated a large amount of blood and secretion by the time they had been transported from the battlefield and anesthetized. We believe that

TABLE IV.—ANESTHETICS

	Cases	Total
Gas-oxygen-ether		
Endotracheal.....	18	57
Ether		
Open drop.....	13	
Endotracheal (Flagg).....	277	
Tracheotomy (open drop).....	26	316
Sodium pentothal.....		391
Sodium pentothal and nitrous oxide.....		5
Sodium pentothal and nitrous oxide with tracheotomy.....		5
Cocaine, topical.....		2
Local infiltration and block.....		293
None.....		79
		1148

routine aspiration was in part responsible for the total absence of postoperative pneumonia in the reported series of cases. Neither were there any demonstrated cases of atelectasis, and only once was it necessary to use the bronchoscope before a patient left the operating table.

To introduce the endotracheal tube a laryngoscope with a flat blade was preferred because the tongue was displaced less by it than by the large half-round type. The laryngoscope was useful not only in passing the tube under direct vision but also in clearing the pharynx of blood, secretion, and the bits of fractured bone or teeth which were often found there. Immediately after the tube was passed, it was connected to the ether can, which will be described later. Then the pharynx was again carefully cleansed under direct vision, and 2 to 4 feet of gauze moistened in warm water or saline solution was lightly packed about the tube, to prevent aspiration of blood and secretion. Neither mineral oil nor vaseline was used because the surgeons objected to the mess of the oil on their hands and instruments. Seventy-five consecutive cases were closely followed postoperatively; no serious pharyngitis or hoarseness was noted.

A modified Flagg can was always used for the administration of endotracheal ether. This simple apparatus consisted of a bent metal adapter to which was attached a thick walled rubber tube,  $\frac{1}{2}$  inch inside diameter and 5 to 10 inches long, which led into the ether can. The tube should not be longer than 12 inches at the most, to avoid a large dead air space and its attendant accumulation of carbon

dioxide. The "ether can" was a 14 ounce evaporated milk can with two  $\frac{5}{8}$  inch holes in the top. The inspired air was drawn over the  $\frac{1}{4}$  to  $\frac{1}{2}$  inch of ether in the can and thence through the tube and into the lungs. This sufficed to keep the patient in light surgical anesthesia. If the plane of anesthesia became too light its depth could be increased simply by lowering the tube further in the can, or even by warming and gently agitating the can with the hand. Oxygen was administered, when needed, through a catheter inserted in the open hole of the can.

This method of administering ether was greatly favored by our team. The apparatus was easy to clean, could be covered by drapes, and was almost completely automatic; as the patient became more deeply anesthetized his respiration became more shallow and less ether was vaporized. The hazard of explosion was controlled by having the maxillofacial table situated at the end of the operating tent away from central supply and from stoves, when they were used.

Gas-oxygen-ether could have been used more frequently, but since 8 to 10 operating tables were being used simultaneously, it was felt that the two gas machines could best be used for the abdominal and chest cases. Approximately 50 per cent of the ether patients were inducted with gas-oxygen-ether and then intubated. The tube was then connected to the Flagg can, freeing the gas machine for other uses.

Though it was a rule that no patient whose wounds communicated with any of the air passages, including the paranasal sinuses, should receive pentothal, Table IV reveals a relatively high number of pentothal anesthetics administered. This was possible only because approximately one-half of the wounds in this series did not communicate with air passages.

Intubation under pentothal anesthesia was accomplished in some instances, but the tendency to severe laryngospasm and coughing made such procedure unpopular. Ethel chloride and drop ether, used for induction in about 25 per cent of the patients, were especially reserved for those who had extensive wounds of the mouth, to get them through the

excitement stage quickly and quietly. Patients were merely brought to a state of unconsciousness with ethyl chloride spray; then a fresh mask was applied and the administration of drop ether was begun. One death can probably be attributed to ethyl chloride induction.

Sodium pentothal was frequently used for patients requiring operation on the posterior neck. In such instances it was most convenient, from the anesthetist's point of view, to use the neurosurgeon's occipital headrest. Not only was the airway then easy to maintain but the surgeon also welcomed the resultant stability and adjustability of the patient, who could be settled in a comfortable position while still awake.

Seventy-nine patients received no anesthetic. Nearly all of that group had burns of the hands and face requiring a minimum of painful manipulation. All had received a preoperative injection of  $\frac{1}{4}$  to  $\frac{1}{2}$  grain of morphine.

#### POSTOPERATIVE CARE

Postoperative treatment of plastic maxillofacial injuries was guided in part by the length of time the patient was to remain in our installation. The hospital operated under directives declaring chest and abdominal injuries nontransportable for 7 and 10 days, respectively; therefore retention of the severely injured plastic maxillofacial patients did not at any time interfere with its mobility. Since all the latter type patients were operated upon under a general anesthetic which was administered through either an endotracheal catheter or a previously placed tracheotomy tube, scrupulous attention to their postoperative care was required.

*Early postoperative care.* During the anesthetic and opiate recovery period it was essential to maintain a dry airway, to correct dehydration and shock, and to continue chemotherapy.

It was not necessary to remove the endotracheal catheter immediately after surgery, and leaving it *in situ* conferred two advantages: (1) it facilitated the maintenance of a patent and dry airway, as did use of a tracheotomy tube, and (2) it expedited the administration of oxygen whenever that procedure was necessary.

Immediately available suction for each patient was imperative. The length of the period during which this procedure was required depended in great part on the amount of material aspirated and on the state of shock. Electrically operated mechanical suction was most desirable, but there was not a sufficient number of such units in the hospital. Consequently, that equipment had to be supplemented by foot pedal apparatus, exhaust suction from gasoline motors, water suction, or a simple syringe suction. Only by utilizing one or more of these supplementary means was adequate suction available in postoperative and shock wards.

The parenteral use of crystalloid solutions for the correction of dehydration and the further use of blood and plasma in the treatment of shock were necessary. When blood was used in a preservative solution containing chloride, care was exercised in the further administration of saline solutions so that water retention might be prevented. We found it better to use 5 per cent glucose in distilled water, rather than saline, under those circumstances.

Chemotherapy consisted of penicillin, 20,000 Oxford units every 2 hours by intramuscular injection, and sulfadiazine, 1 gram every 4 hours by mouth. This was routine, unless special circumstances required other means of administration or different dosage. Sodium sulfathiazole in solution was given intravenously to patients unable to take sulfadiazine by mouth.

*Late postoperative care.* Following the anesthetic and opiate recovery phase, the patients were set upright to facilitate venous drainage and to reduce edema, thus preventing tension on sutures and local anoxia of the involved tissues.

For those patients who had injuries of the oral or pharyngeal cavities, feeding was begun at once by oral or nasal catheter, depending on the nature of the injury. By this means those patients were immediately on a liquid diet containing 2500 to 3000 calories. The No. 18 F. urethral catheter with 50 cubic centimeter syringe was excellent for this purpose. The catheter was removed after each feeding. After two or three lessons the patient could



feed himself. This method not only insured adequate food and fluid intake, but also improved the wound hygiene.

Meticulous hygiene of the cavities was then instituted. This consisted of irrigation with physiological saline solution followed by hydrogen peroxide or potassium permanganate solution. Sinuses or bones exposed by extensive loss of tissue were sprayed with activated zinc peroxide solution. Here again, after two or three lessons, the patient welcomed the opportunity of caring for himself.

When adequate early surgical treatment was carried out it was seldom necessary to allow the tracheotomy tube to remain in place for more than 4 days. Throughout the period covered by this report a high percentage of tracheotomy tubes were removed before the patient was evacuated, and during the last 5 months all tubes were removed before that time. In no case did follow-up records reveal any ill effects. We believe that there is a tendency to allow the tube to remain in place longer than its period of usefulness, thereby prolonging the time required for closure and increasing the amount of scar tissue.

#### BURNS

Practically all burns seen at this evacuation hospital were second or third degree burns. In approximately 70 per cent of the cases morphine was sufficient for débridement and dressing. The remaining 30 per cent had additional injuries requiring administration of a general anesthetic. Petrol and flash burns of the extremities were treated, following débridement, with the application of fine mesh vaseline gauze, pressure dressing, and immobilization.

Due to gross contamination by excretions from nose and mouth, dressings were not used on the face, except for evacuations. When patients arrived at the ward they were placed in Fowler's position on a sterile sheet with a sterile towel for pillow cover. As a result of maintaining this position less edema developed.

All phosphorus burns admitted to the hospital had received previous application of copper sulfate. Even so, the more deeply imbedded particles required excision, but if this were

unnecessary the burns were treated as petrol or flash burns.

Three civilian children with third degree burns of face and hands were treated with excision, full thickness skin graft to the face, and split thickness grafts to cover the hands. This treatment was adopted because both evacuation to civilian hospitals and later care were very uncertain.

Postoperative treatment of burns entailed (1) administration of blood and blood plasma for hemoconcentration, (2) chemotherapy, and (3) the maintenance of adequate fluid intake.

#### DEATHS AND THEIR CAUSES

CASE 1. Clinical diagnosis: perforating wound of face, resulting in compound comminuted fracture of the mandible, bilateral horizontal compound comminuted fracture of the maxilla, and extensive lacerations of the face. Cause of death: irreversible shock.

CASE 2. Clinical diagnosis: perforating wound of neck, with perforation of larynx. No operation performed. Cause of death: emphysema with cellulitis.

CASE 3. Clinical diagnosis: perforating wound of the face: portal of entry was in the region of the left temporomandibular joint, and exit was through floor of the mouth. No operation performed. Cause of death: hemorrhage from internal maxillary artery.

CASE 4. Clinical diagnosis: multiple perforating wounds, with third degree burns of both legs. Cause of death: irreversible shock.

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# SUMMARY AND CONCLUSIONS

1. Two cases with successful primary closure of the cervical esophagus are reported.
2. Endotracheal anesthesia is preferred in the severely injured maxillofacial patient.
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5. Primary closure of neck and face wounds is the treatment of choice.



## TRANSVERSE PRESENTATION

JOHN TOTTERDALE COLE, M.D., and FORBES DELANY, M.D., New York, New York

A REVIEW of early obstetrical literature reveals that abnormal presentations usually ended with destruction of the fetus. But as obstetrics emerged as an art, with its goal a healthy mother and infant, instruments and methods were devised to cope with the problem of transverse presentation. Internal version, external version, forceps, and cesarean section have reduced the number of unfavorable results. The accumulation and the intelligent interpretation of statistical data have further reduced mortality.

Stephenson reviewed the original paper of Sir Thomas Denman (1785) who superficially described the mechanism involved in 3 cases of neglected transverse presentation in which spontaneous delivery eventually occurred. He ascribed the term spontaneous evolution to this rare outcome. Stephenson also reviewed the original paper of Douglas (1819) who made a more searching inquiry of the phenomenon. Roederer (1756) described *partus con- duplicato corpore*, or birth with the doubled body. Eastman again reviewed the subject in 1913. In modern obstetrics this form of delivery is of historical interest and is only rarely seen in the neglected case. Modern teaching insists upon some form of interference when a patient is encountered with a persistent transverse presentation. The physician who pursues a course of watchful waiting in these difficult cases invariably finds himself driven to

desperate and heroic therapy, often resulting in death of the infant and/or the mother.

In the late 1800's an abundance of German literature appeared concerning the treatment of transverse presentation by internal podalic version. Most authors accepted internal podalic version as the treatment of choice, and were chiefly concerned with the state of the cervix at the time such interference was justified. Sachs and Poeck later (1926) summarized the opinions of leading German obstetricians about half of whom felt that internal version should be performed prior to full dilatation, and the other half believed that internal version was not indicated until full dilatation of the cervix had occurred. Cesarean section was not entirely forgotten, but it was thought that the operation was not indicated unless additional factors were present. Kamniker stated that the mother should realize the added risk, and her wishes should be considered. Chatunzew was of the opinion that cesarean section was indicated in cases in which the membranes ruptured early and that both fetal and maternal mortality should be reduced by such treatment. In the more recent American literature series of cases have been reported by Eastman, Novey and Schneider, and Torpin. Eastman's series covered the period from 1846 to 1931, and Novey and Schneider's series the period from 1920 to 1930. It is the purpose of this paper to present a more recent series of cases, and if possible, to evaluate the influence of advances in surgery, chemotherapy and the development of

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blood banks, which appear to be influencing the method of treatment in cases of transverse presentation.

In a review of the records of 45,000 deliveries at The Woman's Clinic of The New York Hospital between 1932 and 1946, 78 cases of transverse presentation are recorded. Arbitrarily, all cases of twin deliveries in which the second twin was transverse have been eliminated since in this instance the problem is not the same. Cases in which the original presentation was transverse and spontaneous version occurred have also been eliminated because many such cases were not reported and one could not be certain of the validity of the findings. It was also necessary to eliminate cases in which the fetus weighed under 1500 grams, for here again many were not reported and they apparently offered no special problem. However, it was just as necessary to include the group in which the fetus weighed between 1500 to 2000 grams as will be pointed out later. The authors fully realize that cases in this group went unrecognized or were not reported, and the incidence of transverse presentation in which the fetus is between 1500 to 2000 grams must be greater than indicated in their series. No attempt has been made to differentiate between the so-called oblique presentation and transverse presentation. The broad definition of transverse presentation—where the long axis of the fetus crosses the long axis of the mother—has been used throughout the study (Chart 1).

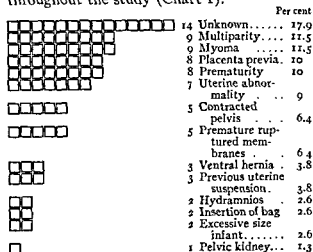


Chart 1. Etiological factors in 78 cases of transverse presentation.

The importance of the etiological factor lies in its influence on the plan of treatment of each individual case. As in other series of cases it was difficult in a large number of instances to determine the reason for the abnormal fetal presentation. In general, the findings are much the same as those of other investigators. Myoma uteri was considered the etiological factor only in those cases in which the myomas were of such size that they might presumably affect the presentation of the fetus. When there was no other obvious etiological factor, the cause was attributed to multiparity if the woman had previously given birth to two or more infants, to prematurity if the infant weighed under 2500 grams, and to excessive size infant if the infant weighed more than 4000 grams. It is evident that it would be more proper to call these the probable etiological factors. Of unusual interest is the single case of transverse presentation in which the causative factor was the presence of a kidney overlying the pelvic brim as proved at operation. This patient had had one previous pregnancy which was also complicated by a transverse presentation terminated by cesarean section.

TABLE I.—DISTRIBUTION OF 78 CASES OF TRANSVERSE PRESENTATION ACCORDING TO PARITY

Parity	No. cases	Per cent
0	17	21.8
1	26	33.3
2	20	25.6
3 or 4	9	11.5
5 or more	6	7.7

Total-78 Total-99.9

Average-1.8

A tabulation of the 78 cases of transverse presentation according to parity again emphasizes the influence of multiparity as an etiological factor (Table I).

TABLE II.—DISTRIBUTION OF 78 CASES OF TRANSVERSE PRESENTATION ACCORDING TO BIRTH WEIGHT OF THE INFANT

Infant weight in grams	No. cases	Per cent
1500-2000	2	2.6
2000-2500	14	17.9
2500-3000	13	16.7
3000-3500	25	31.1
3500-4000	17	21.8
4000-4500	7	8.9

Total-78 Total-100.1

Average-3003 grams

A distribution of the patients according to the birth weight of the infant shows the greatest number of cases of transverse presentation occurred when the infant weighed between 3000 and 3500 grams (Table II).

# FETAL MORTALITY

The fetal mortality figures reported by the German authors vary widely, being from 19.0 to 47.2 per cent. This appears to be due to the fact that some authors included in their series all cases in which the fetus weighed 1000 grams or more. It is obvious that some clinics were seeing many more neglected cases of transverse presentation than others. Novey and Schneider report the fetal mortality to be 30.7 per cent in 114 full term infants at the University Hospital, Baltimore. Eastman's figure is 47.2 per cent in 93 cases at the Johns Hopkins Hospital when the fetus weighed 2500 grams or over, and 30.0 per cent when he eliminated the cases in which the fetal heart was not heard on admission to the hospital. In the present series, there were 62 cases in which the birth weight of the infant was 2500 grams or more, and 9 fetal deaths occurred (14.5%). If the 4 cases are discarded in which the fetal heart was not heard on admission to the hospital, the fetal mortality was 8.6 per cent (Table III).

TABLE III.—FETAL MORTALITY IN 62 CASES OF TRANSVERSE PRESENTATION IN WHICH THE FETUS WEIGHED 2500 GRAMS OR OVER

Classification	No cases	No deaths	Per cent Mortality
Total cases	62	9	14.5
Fetal heart present	58	5	8.6
Method of delivery			
Vaginal	28	5	18.0
Abdominal	30	0	0.0

In the entire series of 78 cases there were 18 fetal deaths. As will be noted from Table IV, 7 deaths occurred prior to the onset of labor, 8 were associated with labor and delivery, and 3 were neonatal deaths.

These fetal mortality figures are lower than generally reported. We believe that this fact is due to our high incidence of delivery by cesarean section which in turn has been influenced by the development of blood banks and advances in chemotherapy, particularly the introduction of the sulfonamide drugs and

TABLE IV.—CAUSES OF 18 FETAL DEATHS OCCURRING IN 78 CASES OF TRANSVERSE PRESENTATION

	No. cases	No deaths
Prior to labor		7
Unknown	5	
Hypertensive disease	1	
Pre-eclampsia	1	
During labor		5
Prolapse of cord	4	
Unknown	1	
During delivery		3
Difficulty with aftercoming head	2	
Prolapse of cord	1	
Neonatal death		3
Prematurity	2	
Asphyxia	1	

penicillin. There were 5 live-born infants who sustained injuries during delivery (all delivered by internal podalic version and breech extraction): 2 nerve injuries, 1 intracranial hemorrhage, 1 fractured clavicle, and 1 hematoma of the knee.

# MATERNAL MORTALITY

In the series there occurred 1 maternal death (1.3%), which rate compares favorably with other reports. Eastman records 5 maternal deaths in his cases and makes the interesting observation that all 5 deaths occurred in immature or premature labors, the largest child weighing 2030 grams.

The patient was a 37 year old, black, septipara, tredecimgravid, with negative Wassermann, and normal pelvis. Her expected date of confinement was June 17, 1940. She was admitted to the hospital at 6:30 p.m. on June 7, 1940, because of the absence of fetal movement for 2 days and the onset of mild labor at 1 p.m. accompanied by slight vaginal spotting. On admission no fetal heart sounds could be heard and the patient had a fever of 38 degrees C. which was attributed to intrapartum infection. Abdominal examination revealed a tender uterus and the fetus in transverse presentation. A sterile vaginal examination at 8 p.m. showed the cervix to be soft and 6 centimeters dilated with the maternal surface of the placenta palpable over the entire cervical os. Brisk vaginal bleeding was present so the placenta was pierced by the examining hand, both feet grasped and pulled into the vagina. This controlled the hemorrhage. Anesthesia was discontinued and with each uterine contraction, gentle traction was made on the feet. Fifty minutes later the patient was delivered without difficulty of a 2740 gram, macerated infant. One minute later the placenta was expressed spontaneously and completely. The cervix was inspected and found to be intact. The uterus was explored and no defect noted. The uterus

TABLE V.—METHOD OF DELIVERY IN 78 CASES OF TRANSVERSE PRESENTATION

Method	No. cases	Per cent	No. deaths Maternal	Fetal
Internal podalic version.	39	50.0	1	12*
Cesarean section	36	46.1	0	0
External version—spontaneous delivery	2	2.6	0	0
Spontaneous	1	1.3	0	0

\*Fetal heart heard on admission to hospital

contracted well. The total blood loss was 400 cubic centimeters.

Immediately following delivery the patient received 500 cubic centimeters of whole blood intravenously and was in good condition. One and one-half hours later the blood pressure was found to be 60/20 and the patient was exhibiting the classical signs of shock. The uterus was found to be relaxed, and an additional 400 cubic centimeters of blood and clots were expressed from the uterine cavity. It was apparent that the shock was out of proportion to the blood loss, so the patient was prepared for re-examination of the uterine cavity. At 11:15 p.m. the second examination revealed a rent in the lower uterine segment on the right side and extending into the right broad ligament. The patient was prepared for further transfusions and immediate laparotomy.

A hysterectomy was performed in 42 minutes, during which time the patient received 1050 cubic centimeters of whole blood, but her condition remained critical. One hour after operation the patient had reacted and was rational and co-operative. Her general condition had improved. The blood pressure was recorded at 78/40; the pulse of fair quality but rapid. During the next hour her course was steadily downhill in spite of the transfusion of an additional 500 cubic centimeters of whole blood. She did not respond to the usual emergency drugs, and expired 7 hours after delivery (4 hours after hysterectomy).

#### METHOD OF DELIVERY

It will be noted in Table V that almost half of the deliveries in this series were by cesarean section. In 93 cases of transverse presentation in which the fetus weighed 2500 grams or over and the fetal heart was heard on admission to the hospital, Eastman reports 21 cesarean sections (22.6%). Novey and Schneider record 21 sections in 151 cases (13.9%). In the present series, considering only infants weighing over 2500 grams when the fetal heart was present on admission, there were 58 cases of which 30 were delivered by cesarean section (51.7%).

Table VI describes the methods of treatment and delivery in greater detail.

TABLE VI.—DETAILS OF METHOD OF DELIVERY IN 78 CASES OF TRANSVERSE PRESENTATION

No. cases	Method
36	Cesarean section
	Classical..... 27
	Low-flap..... 6
	Porro..... 1
	Extraperitoneal..... 1
28	Internal podalic version and breech extraction
5	Intrauterine bag, internal podalic version, breech extraction
3	Attempted external version, internal podalic version, breech extraction
1	Intravaginal bag, internal podalic version, destructive operation
1	Abdominal binder, internal podalic version, breech extraction
1	External version, binder, internal podalic version, destructive operation
1	External version, abdominal binder, spontaneous delivery
1	External version, manual fixation of head, spontaneous delivery
1	Spontaneous delivery

#### TREATMENT

In the treatment of transverse presentation no strict regimen can be outlined for all cases. To some extent the treatment of an individual case depends upon certain variable factors.

1. Etiological factor. The presence of a pelvic tumor, contracted pelvis, uterine abnormality, or placenta previa might contraindicate vaginal delivery and make cesarean section mandatory. Conversely, the presence of a premature infant might influence the attending physician to allow delivery from below. But as previously pointed out, Eastman's 5 maternal deaths occurred when the infant weighed 2030 grams or less.

2. Age and relative sterility of the patient. In the elderly primipara with a long history of relative sterility, the importance of the fetus is greater. In such a case one would be inclined to choose cesarean section as the method of delivery. Again, one would surely hesitate to perform a hysterectomy on a neglected young primipara, and would use every means to preserve the organ for future pregnancies.

3. Duration of pregnancy. If confronted with a previable infant, radical measures are to be avoided. Under certain conditions one would be more inclined toward vaginal delivery when the fetus was small, and toward cesarean section when the fetus was excessively large.

4. Condition of fetus. If the fetus is in dire straits, clinically dead, or malformed, delivery from below is usually indicated and cesarean section to be avoided.

5. Duration of labor. When abdominal delivery is decided upon, the duration of labor affects the selection of the type of cesarean section to be performed. As labor becomes protracted, thinning of the lower uterine segment makes external and internal version increasingly hazardous procedures.

6. Condition of the membranes. With rupture of the membranes and the escape of the amniotic fluid, prolapse of the cord is an ever-present and extremely unwelcome complication. External version is more difficult, often impossible, and frequently injudicious. Braxton Hicks or internal podalic version may lead to fetal death unless the patient may be immediately delivered.

*Antenatal care.* Novey and Schneider emphasize the importance of adequate prenatal care. During the antenatal period careful examination would reveal the presence of a pelvic tumor, contracted pelvis, uterine abnormality, hydramnios, or an excessive size infant. The attending physician would then have some insight as to the cause of a persistent transverse presentation as the patient approached term. If such conditions were overlooked their recognition might prove much more difficult at time of labor. The multipara with a pendulous abdomen or ventral hernia may obtain great relief from an abdominal support during the latter months of pregnancy, and at the same time the likelihood of transverse presentation is reduced. Although most physicians are reluctant to accept external version as a routine procedure as advocated by Ryder, its use in the last few months of pregnancy when a transverse presentation is discovered is of value. If studies during the antenatal course indicate that abdominal delivery will be necessary, the patient may be admitted to the hospital at or near term for elective cesarean section.

*Precautions.* It has been the policy of the Woman's Clinic of The New York Hospital to take certain precautions when a patient is admitted with the fetus in transverse presentation. Immediate blood typing and matching

is performed in anticipation of a difficult delivery. If the etiological factor is unknown or obscure, a careful search is carried out to determine the presence or absence of pelvic contraction and fetal abnormalities. Soft tissue x-ray films may also be done when placenta previa or pelvic tumors are suspected. A sterile vaginal examination may be performed. Prophylactic sulfonamide drugs and/or penicillin may be administered.

*Observation.* At all times the patient should be under close surveillance for signs of impending uterine rupture. Auscultation of the fetal heart is carried out at frequent intervals so that the first signs of fetal embarrassment will be noted. Constant watch is kept for rupture of the membranes and the prolapse of a small part or the cord.

In discussing the treatment of transverse presentation the methods to be employed seem naturally to fall into groups which are directly dependent on the duration of labor and the condition of the membranes.

*Early labor. Membranes intact.* It would be interesting to know just how many times spontaneous versions occur. It is probably safe to assume that in one-half or more of cases the fetus rotates spontaneously so that either the vertex or breech presents. External version should be attempted. If it is successful, the presenting part should be fixed manually over the pelvic brim until it is secure; if unsuccessful, the patient is entitled to a short trial of closely observed labor to allow every opportunity for spontaneous version to occur. Although many advocate the use of abdominal binders to maintain the new presentation, we have found spontaneous reversion to the transverse to be common. With an abdominal binder in place auscultation of the fetal heart and abdominal palpation are difficult. Often one is lulled into a sense of false security only to find as labor progresses and the membranes rupture that the cord or a small part is present in the vagina. If absolute indications are present for cesarean section, the patient should be prepared for operation.

*Early labor. Membranes ruptured.* In this instance the treatment is much as outlined above, but once the membranes are ruptured external version becomes a dangerous pro-



cedure unless the cervical os is tightly closed and a sufficient quantity of amniotic fluid remains. If external version is successful, some writers advocate the use of the Willett clamp to maintain the fetal head in the pelvis. We have had no experience with this method.

*Midlabor. Membranes intact.* At this stage cesarean section remains feasible. As previously pointed out, hysterectomy may be performed in the multipara who is grossly infected. On the other hand, in the primipara every attempt should be made to save the uterus. Intrauterine bags are of questionable value in aiding in the further dilatation of the cervix and preventing prolapse of the cord or a small part. They may sometimes be used to control hemorrhage when placenta previa is discovered. Eastman advises the use of an intravaginal bag to exert counterpressure and so prevent rupture of the membranes. Our experience with the intravaginal bag has been limited and not satisfactory, for the bag has failed to prevent rupture of the membranes and has proved to be extremely painful.

*Midlabor. Membranes ruptured.* Here the treatment is much the same as outlined for midlabor and intact membranes. The inter-vaginal bag, however, has no use once the membranes are ruptured.

*Terminal labor.* Once the cervix is fully dilated or nearly so, internal podalic version and breech extraction may be carried out. The available statistics show that this method of treatment carries with it a high fetal and greater maternal mortality rate. It is one of the leading causes of uterine rupture, and, in transverse presentation this is particularly important, for the lower uterine segment is often very thin or a low implanted placenta may be present. A review of the maternal deaths reported in cases of transverse presentation always shows a large number of the deaths attributed to rupture of the uterus following internal podalic version and breech extraction, while the occasional case is due to infection or hemorrhage. At the Woman's Clinic of The New York Hospital, Pastore found the average blood loss at delivery to be 244 cubic centimeters. The 38 cases of transverse presentation delivered by internal podalic version and breech extraction had an

average blood loss of 335 cubic centimeters. Six of these cases suffered a postpartum hemorrhage (15.8%). We can only counsel as do Novey and Schneider, that unless certain requirements are satisfied (particularly a sound uterus, the absence of tumors, lack of disproportion and a sufficient quantity of amniotic fluid), internal podalic version is extremely hazardous. If these requirements are not satisfied internal podalic version should not be attempted, but rather the fetus be sacrificed in a destructive operation. When the cervix is fully dilated and the fetus dead, the least traumatic procedure attended by the smallest risk is a destructive operation, particularly exenteration.

#### DISCUSSION

An investigation of the high fetal mortality rate associated with transverse presentation revealed that 7 deaths occurred prior to the onset of labor, 8 were associated with labor and delivery, and 3 were neonatal deaths. The 1 maternal death is recorded in detail.

The treatment of transverse presentation is discussed at some length. In order further to reduce fetal and maternal mortality, stress should be placed on good antenatal care, the observance of certain precautions in anticipation of a difficult delivery, and the intelligent evaluation of the individual case as to method of delivery. The high mortality figures that accompany delivery from below are pointed out, and the complications that arise from unwise internal podalic version and breech extraction are emphasized. The development of blood banks and the recent advances in chemotherapy should further reduce the number of deaths. The more frequent employment of cesarean section as the method of delivery in transverse presentation is indicated because of the attendant low mortality figures.

#### SUMMARY

1. Seventy-eight cases of persistent transverse presentation occurring in approximately 45,000 deliveries at the Woman's Clinic of The New York Hospital are reported. A brief account is given of the probable etiological factors, and a tabulation of the cases according to parity again emphasizes the importance of multiparity.

2. One maternal (1.3%) and 18 fetal (23.1%) deaths are recorded. In 58 cases in which the fetal heart was audible on admission to the hospital and the infant weighed 2500 grams or over, 5 fetal deaths occurred (8.6%).

3. This series differs from others in that in 46.1 per cent of the cases delivery was by cesarean section, and in this group there were no fetal or maternal deaths.

NOTE.—Since this study was completed, in 5 further cases of transverse presentation delivery was by cesarean section without fatality.

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# GASTRIC CANCER: LAPAROTOMY, RESECTABILITY, AND MORTALITY

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THE purpose of this paper is to analyze the present status of the surgical treatment of gastric cancer with respect primarily to exploratory laparotomy, resectability, and postoperative mortality.

The only effective treatment of gastric cancer at present is surgical resection. The progress made in the perfection of this procedure is indicated by the increasing number of patients submitted to operation, the lowered mortality rates, and the longer periods of postoperative survival. However, the published statistics are quite variable and evidence different concepts of operability and resectability as well as different mortality and survival rates.

From the Charity Hospital in New Orleans, Morris reports 1,163 patients with gastric cancer, admitted between 1932 and 1940, of which 829 were considered inoperable; 344 were subjected to operation with 138 hospital deaths. In a special group of 200 patients subjected to operation, the same author reports 55 gastrectomies with a mortality of 56 per cent. In 1931, the mortality of gastric resection at that institution was 51.4 per cent while in 1942, it was 16 per cent.

From Seattle (13) are reported 273 gastric cancers with only 12 resections and 6 survivors. Emmet describes 74 cases with 24 gastrectomies and a mortality of 20 per cent. At the Cincinnati General Hospital (22), between 1932 and 1936, 42 per cent of the patients with gastric cancer underwent operation with a resection rate of 9 per cent; by 1939, the resection rate had risen to 43 per cent. Thorstadt reports 454 patients from Harper Hospital with 57.7 per cent operability, 19.4 per cent resectability and a gastrectomy mortality of 64.7 per cent while at Receiving Hospital, a municipal institution, he

found 23.4 per cent of 516 patients operable and 9.8 per cent resectable with a gastrectomy mortality of 57 per cent. This percentage suggests that operability and resectability decreased as the economic level was lowered. Livingston and Pack quote Sandweiss (12, p. 15) to the effect that 7.7 per cent of the patients with gastric cancer in Detroit received resection and 3 per cent reached the stage of resection survival. In an extensive survey, Baron found 25 per cent of explored patients resectable with a 30 per cent resection mortality (3).

Table I shows that the operability of gastric cancer varies from less than 25 per cent at some institutions to more than 89 per cent at others while resection mortalities range from 4.9 per cent to 64 per cent. In order to avoid confusion these statistics must be carefully analyzed and interpreted particularly with respect to the following 4 factors: (1) the total number of patients with gastric cancer, (2) the number subjected to exploration, (3) the number in which resection of the primary growth is accomplished, and (4) the number of survivors in relation to the total.

## ANALYSIS OF CASE DISPOSAL

At the University of Chicago over a 17 year period (1927 to 1944) some 576 patients with gastric carcinoma were examined. In a study of the disposition of the unselected total it was noted that laparotomy was advised in 71.8 per cent, not advised in 13.3 per cent and refused in 4.3 per cent. Of the group 67.5 per cent accepted exploration, 35.3 per cent underwent resection, and 26.05 per cent survived resection. A detailed examination of the case disposal, however, reveals that 85, or 14.7 per cent, of the 576 did not return for definitive advice or were admitted for special procedures such as gastroscopy. Of the 491 who did return for advice, laparotomy was not advised in 77 (16.5 per cent) refused in 25 (5.1 per

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TABLE I.—COMPARATIVE STATISTICS CONCERNING LAPAROTOMY, RESECTABILITY, AND MORTALITY

Reference	Author	Period surveyed	Patients in series No.	Laparotomy Per cent	Resectability of total Per cent	Resection Mortality	
						Simple Per cent	Complicated or radical Per cent
12	Peck		577	77.4	14.8	28	
10	Joll	1920-1940	*	1368	123	19	
19	Thorstadt (Receiving Hospital)	1928-1942	516	23.4	9.8	57	
19	Thorstadt (Harper Hospital)	1928-1942	454	57.7	19.4	64.7	
11	Labey	To 1940	311	69.1	44.6	*	
6	Counsellor, Waugh, Clagett	1943	538 Approximate	60	35	4.9	29.4
20	Walters, Gray and Priestly	1907-1938	10,890	57.3	25.5	16.2	
4	Bocharov	1928-1938	1,020	89.8	34.2	32.4	
8	Engels		*	42	17	5	25
	University of Chicago	1928-1943	466	83.5	43.5	20.8	51.4
18	St. John, Swenson, Harvey	1938-1942	244	*	36.5	17.9	
16	Hansen (Denmark)	1930-1940	1,547	*	19.7	41.5	
16	Weese (Tubingen)		883		35 Approximate	17.3	41
16	Finsterer		*	*	*	6.1	39
16	Kiel Clinic		*	*	*	*	44
3	Baron (Spain)		440	44	20.4	38	80
17	P rat (Uruguay)		130	25	11	50	

\*Not stated †Cases

cent), and performed in 389 (78.4 per cent). Thus 466 patients, 80.9 per cent of the total group of 576, accepted the physician's advice and form the basis of a more accurate evaluation as to surgical intervention.

#### LAPAROTOMY AND RESECTABILITY

Of the 466 patients who followed the advice given laparotomy was carried out in 389 or 83.5 per cent; the remaining 16.5 per cent were considered inoperable. Metastases to the liver or to distant organs and carcinomatous involvement of the peritoneum constituted the major contraindications to operation. Exploration alone was carried out in 20.1 per cent while palliative procedures consisting of gastrostomy, gastroenterostomy and jejunostomy were performed in 19.7 per cent. Resection was possible (Table II) in 203 cases, 43.5 per cent. Partial resection was the most widely employed operation, 36 per cent (of 466) being subjected to this procedure. Total gastrectomy (transabdominal 3.5 per cent and transthoracic combined with partial esopha-

gectomy 4.2 per cent) formed a relatively small part of the effective surgical measures. The resection rate of 43.5 per cent is high and indicates that the procedure was undertaken in a number of patients who presented far more than the average risk. Approximately 25 per cent of the partial resections were complicated by metastatic involvement of neighboring organs. Partial resection of the liver, pancreas, colon, removal of the spleen, and extensive lymph node dissections were often performed. Of the total patients undergoing partial resection, 79.2 per cent survived and were discharged from the hospital; approximately half of the patients undergoing transthoracic and transabdominal total gastrectomy were discharged, the mortality in 35 patients subjected to these procedures being 51.4 per cent. A total of 150 patients survived gastrectomy of all types. Figured on the basis of the 466 patients who sought advice, these 150 represent 32.2 per cent; when figured on the basis of the 389 subjected to exploration they constitute 38.8 per cent.

TABLE II.—OPERATIVE PROCEDURE AND MORTALITY (466 CASES)

Procedure		Number of patients	Per cent of total	Operative mortality Per cent	Operative survival Per cent
Laparotomy not advised		77	16.5		
Resections	Partial	168	36	20.8	79.1
	Transabdominal total gastrectomy	16	3.5	41.7	58.3
	Transthoracic gastrectomy and partial esophagectomy	19	4.1	57.8	42.1
	All types	203	43.5	26.1	73.8
Palliation					
	Jejunostomy	91	19.7	15	84
	Gastroenterostomy				
	Gastrostomy				
Exploration		64	13.7	13.6	86.4
Total operations		380	81.5	13.3	86.7

## POSTOPERATIVE MORTALITY

The mortality in the 389 operations was 23.3 per cent, 91 deaths (Table II). In the 203 resections of all types there were 53 deaths, a mortality of 26.1 per cent. In the 168 partial resections there were 35 deaths, 20.8 per cent. Examination of reported rates in the literature seems to reveal a downward trend in the reported rates of resection deaths in experienced hands, although the indications for operation and for resection have varied so greatly that one cannot be certain of this. In the present series, from 1929 to 1940, there were 119 partial resections with a mortality of 22.6 per cent with an operative survival of 77.4 per cent while from 1940 to 1944 there were 49 partial resections, with a mortality of 16.3 per cent with an operative survival of 83.6 per cent. Finsterer reports a mortality of 6 per cent for uncomplicated resection and of 39 per cent for complicated partial resection. Weese found a 17.3 per cent mortality for simple resection and 41 per cent for complicated resections. These figures are somewhat difficult to interpret for the terms "uncomplicated" and "complicated resection" may be defined somewhat differently. Brunschwig has advanced the thought that partial resection of the stomach is comparable to simple mastectomy whereas "complicated" or "radical gastrectomy" is comparable to radical mastectomy wherein extensive lymph node and neighborhood structures are resected in an effort to remove or prevent metastases.

The high mortality for transthoracic resection may be due to the small number of cases

or it may reflect the initial surgical experience with this procedure in this institution. More favorable progress is indicated by a recent report for this operation in this institution by Phemister and Adams of 33 transthoracic resections for carcinoma of the cardiac end of the stomach or the lower esophagus with 21 survivors; in a later series (Adams) there were 8 survivors in 10 such resections.

A mortality of 13.6 per cent was noted for exploratory laparotomy only. Palliative operations, gastroenterostomy, gastrostomy and jejunostomy, had a mortality rate of 26.1 per cent—the same as that for all types of resection and presumably not offering the degree of palliation provided by resection. Anschutz reports that palliative resection in his hands carried a 32 per cent mortality but allowed 54 per cent of 99 patients to survive 1 year, 21 per cent to survive 3 years, 8 per cent to survive 5 years, and 5 per cent to survive 8, 10, and 15 years. This suggests that more attention be focused on palliative resection as a substitute for gastroenterostomy, gastrostomy, and jejunostomy.

## POSTOPERATIVE DEATHS

In 35 deaths following partial or total gastrectomy, 7 were associated with the extensive removal of other viscera because of neoplastic involvement; 18 followed total transthoracic or transabdominal gastrectomy. Fifteen patients died between the 1st and 3rd postoperative days; 16 between the 3rd and 7th days; 5 between the 14th and 21st days and 5 between the 21st and 29th days. Thus 31

patients, or 58.5 per cent of the deaths, died during the first postoperative week.

In 25 per cent of the patients dying postoperatively after resection, no detectable metastases were found at autopsy. This fact suggests that at least 25 per cent of the patients undergoing resection have a good chance of surviving 5 years or longer. In a recent report by Metheny (14) of 143 patients who died without operation, the lesion was confined to the stomach in 10 per cent and was theoretically curable by resection in 18 per cent.

Peritonitis, the chief cause of death (Table III) was due in some cases to suture leakage; in others the suture lines were intact. Pneumonia was the next important complication in 8 cases and directly caused death in 6. Other occasional causes of death were: shock from extensive operative procedures, mediastinitis, pulmonary embolism, pancreatic abscess, and granulocytopenia.

#### DISCUSSION

It is evident (Table I) that to a certain extent the indications for operation and resection in gastric cancer are matters of opinion, one report indicating that only 23.4 per cent of the patients were considered suitable for laparotomy whereas in another the figure is 89 per cent. Some clinics and groups with large experience lean toward the conservative view while other groups hold the more radical views. In this series the laparotomy rate was 83.5 per cent, higher than any we have found in the literature with the exception of the 89.9 per cent reported by Bocharov. Likewise, the resectability rate of 43.5 per cent was the highest found in the literature with the exception of the 44.6 per cent rate reported by Lahey. These figures probably reflect in part the difficulty in determining the possibility of resection without operation. The present trend is definitely toward a higher laparotomy rate and the acceptance of greater hazards in resection. This trend results from recognition of the following facts: (1) surgery offers the only hope of cure, (2) palliative resection is very much worth while, and (3) the mortality rate has progressively diminished in spite of the acceptance of greater hazards, the diminu-

TABLE III.—CAUSE OF DEATH  
GASTRECTOMY ALL TYPES

	Cases	Autopsies
Peritonitis.....	17	15
Cause not stated.....	11	0
Peritonitis and pneumonia.....	8	8
Pneumonia.....	6	3
Shock.....	5	1
Mediastinitis.....	2	2
Peritonitis and embolism.....	1	1
Embolism pulmonary.....	1	1
Pancreatic abscess.....	1	1
Granulocytopenia.....	1	1
Total.....	53	33

tion being due to greater surgical skill, immediate prophylactic treatment of shock with transfusions of blood and plasma, and improved preoperative and postoperative care.

The factors responsible for the variations in resection mortality are not always available from reports. Livingston and Pack found only 3 instances in the United States, of published records of over 100 total gastrectomies for gastric cancer prior to 1939 and only 3,000 partial resections. Of all institutions reporting, 98 per cent had less than 2 resections per week while the great majority had less than 6 per year.

#### SUMMARY

1. Of 576 patients in whom the diagnosis of gastric carcinoma was made, 491, or 85.3 per cent, came for definitive advice and 466, or 80.9 per cent, accepted the advice.

2. In this group of 466, laparotomy was recommended and carried out in 389, or 83.5 per cent.

3. The resectability rate based on the 466 was 43.5 per cent; when based on the 389 submitted to exploration it was 52.1 per cent.

4. The resection survival rate based on the total of 466 was 32.2 per cent, when based on the 203 patients undergoing resection it was 73.7 per cent.

5. The mortality for gastric resection of all types was 26.1 per cent for the 17 years.

6. The mortality in unselected cases of partial resection was 22.6 per cent before 1940, 16.3 per cent after 1940.

7. Peritonitis continues to be the chief cause of postoperative death.

8. No residual carcinoma was demonstrated at autopsy in 25 per cent of the patients dying postoperatively from gastric resection.

## CONCLUSIONS

The data herein presented seem to us to indicate:

1. A definite increase in the percentage of patients considered operable.
2. Higher resectability rates.
3. Lower postoperative mortalities in spite of the greater incidence of complicated and extensive operations.

Considerable progress is thus being made in the only treatment offering any real hope at the present time, namely surgical removal; nevertheless, the outlook for prolonged survival continues to be rather limited.

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## BILATERAL AND MULTIPLE RUPTURED DISCS AS ONE CAUSE OF PERSISTENT SYMPTOMS FOLLOWING OPERATION FOR A HERNIATED DISC

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IT has been firmly established that the acute symptoms due to a herniated lumbar disc can be relieved by removal of the offending disc in most cases. Permanent relief of acute symptoms has also occurred in a large proportion of patients who have been able to avoid undue physical strain after operation.

On the other hand most surgeons will agree that recurrence or, less often persistence, of moderate to severe symptoms following operation for a herniated lumbar disc is by no means uncommon, especially when the patient has undertaken heavy work. The cause of these symptoms is usually obscure. In the great majority of instances they have occurred in patients who have been suffering from a solitary herniation which has apparently been adequately removed. Multiple herniations cannot therefore account for the symptoms in this group. In the present paper further observations (5) are presented, however, which support the belief that these recurrent or persistent symptoms may, at times, be due to the presence of bilateral or multiple ruptured discs which may be overlooked at the first operation.

In 1939 Camp, on the basis of myelographic studies, reported that in his experience 12 per cent of herniated discs were multiple. In the same year Love suggested that in order to avoid overlooking multiple discs it might be wise to use contrast media in all cases, even though protruded discs could be recognized clinically. Since then the occurrence of bilateral or multiple herniated discs has been reported by many observers (1, 2, 3, 6, 7, 8, 9, 13, and others). Childe has remarked, "Multiple disc herniations in the lower lumbar

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region are much more frequent than was originally supposed, and this is another strong argument in favor of routine myelography. All possible combinations exist and as many as six have been diagnosed in one individual." Dandy's observations in 1944 have served to focus our attention even more acutely on this problem for he has stated that, "Inspection of the spinal column explains the cause of defective lumbar discs, their frequency and the fact that they are nearly always multiple or potentially multiple. The high incidence of multiple discs is to be expected and actually obtains in practically all cases."

The problem of diagnosis and treatment in ruptured lumbar disc is far from solved. The present paper stresses one of the reasons why the problem is so complex and perhaps insoluble in certain cases.

In a report of a previous series of cases (5) it was re-emphasized that bilateral or multiple disc herniations may give rise to symptoms suggesting the presence of only a solitary unilateral herniation. For this reason a diagnosis based on clinical findings alone may be unreliable and it is believed that preoperative pantopaque myelographic studies (5, 12, 14, 15, 16, 17) are indicated in all these cases as a helpful adjunct to clinical diagnosis. That myelography also may fail to reveal a disc protrusion is, of course, well known. This fact makes it more apparent that multiple discs are even more common than has been demonstrated.

During the past 10 months (August 1944 to May 1945) 60 patients were operated on for a suspected herniation of a lumbar disc. In 56 of these cases one or more herniated discs were found. In the other 4 patients nothing abnormal was revealed at operation. The preoperative myelograms in the 4 cases had





on both the right and left side. The thinned posterior longitudinal ligament<sup>1</sup> was incised over the dome of the protrusion on the left and several small pieces of nucleus pulposus, which had herniated through the ruptured annulus were withdrawn by traction. A thorough extirpation of remaining nucleus pulposus tissue was then accomplished. The removal was carried across the midline after further retraction of nerve root and dura. Attention was then again turned to the disc herniation on the right and it was found to have been completely unchanged by the extirpation on the opposite side. This portion of herniated disc was then removed in similar fashion to that on the left. At the completion of this procedure it was found that the posterior longitudinal ligament had been incised, and intervertebral disc excised, directly across the midline. This had proved necessary before the posterior herniation of the disc on the right could be relieved. These findings demonstrated to us that when a bilateral herniation of an intervertebral disc exists, removal of the disc from a unilateral approach may not be sufficient to relieve the posterior herniation on the opposite side. In the second case with a bilateral herniation of the nucleus pulposus (Fig. 2) a similar bilateral exploration was performed but this time at the fifth lumbar level. Again a bilateral herniation of the disc was present with bilateral compression of the nerve root. The disc tissue in this case was considerably firmer than in the patient just described and was very difficult to remove. As in the first case, removal on one side had no apparent effect on the degree of herniation on the opposite side, although in this instance extirpation was not carried across the midline. The third case in this group of bilateral herniated discs presented a picture essentially the same as the other two. Myelogram showed a large bilateral filling defect (Fig. 3, a and b). At operation a large protrusion with definite compression of nerve root was visualized bilaterally before removal was attempted. The disc was then approached from the right side and found to be definitely

herniated. The herniated portion of the nucleus was grasped with forceps and by means of traction as much tissue as possible was withdrawn. With the Cushing pituitary rongeur as radical a removal was then carried out as we are capable of doing. The rongeur was thrust downward into the depths of the intervertebral disc and tissue removed in a lateral and anterior direction at first, until all available material was obtained down to the firm fibrocartilaginous portion of the disc. The rongeur was then reversed and removal carried toward the midline and anteriorly until the nose of the rongeur again everywhere freely contacted firm resistance at the anterior limit of the disc. During this procedure the rongeur was at intervals angulated slightly in order to grasp any nucleus pulposus material adherent to the surface of the bodies. This method has proved more satisfactory in our hands than curretting the opposing surface of the vertebral bodies. This was regarded as rather a test case, and hence every effort was made to remove as much of the disc as seemed safely possible. Despite this radical removal on the right, the left-sided protrusion remained intact and had to be removed separately. This protrusion also proved to be a definite herniation of the nucleus pulposus. The large amount of disc tissue obtained from each side is shown in Figure 4. As previously stated, the clinical findings in the 3 patients just reported indicated a unilateral herniated disc. The first patient, however, did give a history of radiation of pain toward the right buttock on several occasions in addition to his usual severe pain which was distributed throughout the course of the left sciatic nerve. Following myelogram the pain began to radiate down the right leg as well as the left. The operative findings of bilateral root compression in the 3 cases cited, we feel, are very good evidence that none of these individuals might have been relieved of symptoms by a unilateral operation (at least in our hands) which would have been the case if clinical symptoms alone, without myelogram, had been relied upon.

It should be mentioned here that in 2 other cases in this series a bilateral protrusion of the disc, demonstrated in the myelogram and

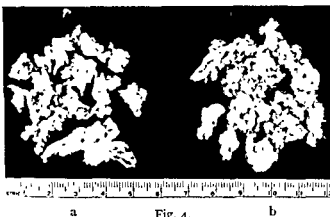
<sup>1</sup>By longitudinal ligament reference is made to that thin membrane or capsule which usually overlies the herniated portion of the nucleus pulposus. This membrane is continuous with the longitudinal ligament but also forms the posterior layer of the annulus fibrosus.





Fig. 1.

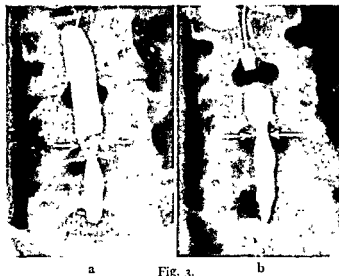
Fig. 2.



a

Fig. 4.

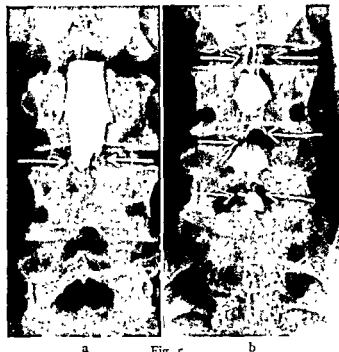
b



a

Fig. 3.

b



a

Fig. 5.

b

the intervertebral disc material removed at operation is shown in Figure 4.

Fig. 4. The photograph shows intervertebral disc tissue removed at operation from the patient whose myelogram is seen in Figure 3. During the operation a herniation of the fourth lumbar disc was found on the right side and an attempt was made to remove as much as possible of the disc from a right sided approach. Photograph a shows the amount of material obtained. Despite this large extirpation of disc substance a marked herniation of the disc persisted on the opposite side and had to be removed through a left sided approach. Photograph b shows the amount of disc tissue obtained from the left side.

Fig. 5. a, The column of pantopaque stops abruptly at the fourth lumbar disc where an apparently complete block exists (arrows). The material was injected at the second lumbar interspace and the patient during fluoroscopy was left in the upright position for about 20 minutes but the pantopaque failed to descend below third lumbar inter-

(Continued on next page)

Fig. 1. This pantopaque myelogram shows an almost complete block at the fourth lumbar interspace (arrows). Pantopaque was injected at the third lumbar level and the patient placed in the upright position. Fluoroscopy and subsequent x-ray examination revealed that only a small amount of the material was able to trickle past the block and pool at the interspace below. At operation a bilateral herniation of the nucleus pulposus was found and a bilateral operation was required to remove it. Clinically the patient was believed to have a herniated disc only on the left side.

Fig. 2. A bilateral filling defect is seen at the arrows. This defect was constant as revealed by fluoroscopy and repeat x-ray films. A bilateral operation was necessary to extirpate a herniated disc which was found to be present on each side at this level (lumbar five). The clinical findings indicated a unilateral herniated disc.

Fig. 3. Myelogram, a, shows a complete filling defect at the level of the fourth lumbar disc. In myelogram, b, same patient, there is a bilateral filling defect at lumbar four interspace. Fluoroscopy left no doubt that a large bilateral defect was present. A bilateral herniation was found at operation and required a bilateral operation to decompress the nerve root on each side. A photograph of



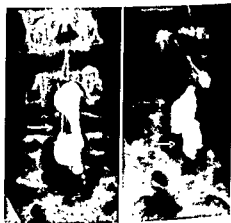
a Fig. 6. b



Fig. 7.



a Fig. 8. b



a Fig. 9. b

space. b, This is a myelogram done on the same patient several days later. The material was injected at lumbar five interspace and ran upward slowly. When the patient was again tilted into the erect position the pantopaque remained very nearly stationary, as shown, indicating an almost complete block at the third, fourth, and fifth lumbar discs (arrows). A large herniation of the disc was found at lumbar three, four, and five levels on the right (the side of the sciatic pain). The left side was not explored. Clinically the patient was thought to be suffering from a herniation of the fifth disc on the right. After myelography operation was postponed for several weeks as we thought at first we were dealing with a diffuse arachnoiditis.

Fig. 6. Two filling defects are revealed in this myelogram, one at the fourth interspace, a, and the other at the fifth, b. Fluoroscopy and repeat x-ray film revealed the defects to be constant and reproducible. Each filling defect outlined a herniated disc as proved at operation. The patient clinically was believed to have only one ruptured disc.

Fig. 7. A unilateral filling defect is seen at the site of the third (top arrow) and fourth (bottom arrow) intervertebral discs. A herniation of both the third and fourth discs was found at the time of operation, even though clinically the patient presented the signs and symptoms of a solitary ruptured disc.

Fig. 8. The patient on whom this myelogram was performed had a large herniation of the disc at lumbar four, a, and at lumbar five level, b. Fluoroscopy demonstrated an almost complete block at lumbar four interspace and a large unilateral filling defect at lumbar five (arrows). His clinical symptoms indicated a herniation of only the fifth disc.

Fig. 9. This is another example where myelography indicated the presence of two herniated discs in a patient who clinically was believed to have only one herniation. At operation a rupture of the fourth disc was proved to be present at the indentation of the pantopaque column as seen in a, and a herniation of the fifth disc at the site of the defect demonstrated in b.



Fig. 10.



Fig. 11.



Fig. 12.

Fig. 10. Myelography showed a large filling defect at the level of the fourth lumbar disc on the right side (top arrow). The lower arrow points to the area of bone removal where a herniated disc (fifth lumbar) was extirpated previously. The patient had persistence of symptoms on the right side following the initial operation. At a second operation a large herniation of the disc was found at the site of the filling defect.

Fig. 11. The filling defect noted at the level of the fourth lumbar disc (top arrow) outlines what proved at

operation to be a large herniation of the disc. The patient on whom we performed this myelogram had had a protruded disc removed elsewhere from the fifth lumbar interspace (bottom arrow).

Fig. 12. Filling defects are present in the pantopaque column at the level of the fourth (middle arrow) and the fifth lumbar discs (bottom arrow). Herniated discs were found at the site of each filling defect. The patient had had a negative operative exploration done elsewhere at lumbar three level (top arrow).

there was a large herniation of the disc at the fifth interspace on the right side, and that this disc was removed. Following this procedure the patient continued to complain of low back and right sciatic pain although he believed this to be somewhat less severe than before operation. A pantopaque myelogram (Fig. 10) was performed by us and revealed a large filling defect on the same side as the original exploration but at the interspace above. At a second operation we removed a disc from the fourth interspace, which was markedly herniated and which caused severe pressure on the nerve root. The history of the second patient was very similar to the one just mentioned and also similar to a case reported by Echols. An accomplished neurosurgeon had removed what, from the operative report, appears to have been a definitely ruptured

intervertebral disc at the fifth lumbar interspace. The patient had complete relief of symptoms for a short period but during bicycle riding had a severe recurrence of his old symptoms. We performed a myelogram (Fig. 11) which revealed filling defects at the site of the old operation and also at the interspace above. At a second operation a large herniation of the disc was found at lumbar four level and extirpated with relief of symptoms. In this case it is possible that the herniation of the fourth lumbar disc occurred after the original operation. However, since no myelogram was performed initially, one is left in doubt concerning this possibility. The third patient in this group had been explored by an excellent surgeon overseas at the third lumbar interspace which he had mistaken for the fourth. His exploration was negative and

the patient continued to complain of symptoms. In a subsequent myelogram (Fig. 12) unilateral filling defects were present at the level of the fourth and fifth discs, on the same side as the first operation. At a second exploration we found a ruptured disc at the site of each filling defect.

The final case in the series was a patient who had a herniated disc removed by a well known neurosurgeon overseas from the fifth lumbar interspace on the right. As a result of this his right sciatic pain disappeared but he continued to complain of low back pain and later of pain down the left sciatic distribution. Myelogram was performed and revealed nothing abnormal. The orthopedic service, on good evidence, believed that spinal fusion might help this man and this was accordingly carried out. During the procedure one of us was asked to explore the fifth interspace on the left side. This was done. The posterior longitudinal ligament was found to be bulging slightly and on palpation felt soft and rubbery. It could not be stated definitely that the nerve root in this case was compressed at the time of exploration. However, on incising the posterior longitudinal ligament the deeper portion of the annulus fibrosus was found to be ruptured and a piece of intervertebral disc of "Y" shape, each limb of the "Y" measuring approximately 1 by  $\frac{1}{2}$  inch, was lifted out of the intervertebral space. This very large piece of intervertebral disc was completely unattached to surrounding tissue and lay free in the intervertebral space between the bodies. (It should be noted that this is the only case included in the group of multiple or bilateral discs in which evidence of nerve root compression was lacking.)

#### COMMENT

Experience in the Army has not proved the problem of herniated disc to be a simple one. Recurrence, or less often persistence, of moderate to severe symptoms, both organic and functional, following operation has been only too frequent, especially when the individual has been required to do heavy work. In the Army a functional element has probably played a greater rôle in precipitating these

symptoms than in civilian life, but in many patients the causative factors are not clear. At least there is a wide difference of opinion concerning their etiology (11). The great majority of patients who have presented such symptoms have suffered from a solitary herniated disc which was apparently adequately removed. As pointed out multiple herniations cannot therefore account for the symptoms in this group. It is believed, however, that the series of cases reported illustrate that bilateral 6.6 per cent of 60 cases or multiple 16.6 per cent of 60 cases herniated discs which may be overlooked at the first operation, may at times account for these persistent or recurrent symptoms.

Clinical findings alone will usually fail to indicate the presence of more than one herniated disc and therefore cannot be safely relied upon to disclose the multiple lesions under discussion. Myelographic studies with pantopaque are very helpful in revealing the presence and level of such lesions and in our opinion are indicated in all cases before operation. This procedure, however, may occasionally also fail to reveal a ruptured disc, especially when it lies far laterally. In the presence of a negative myelogram, decision to operate will depend upon the severity of the symptoms and whether or not the clinical picture is characteristic of a herniated disc. Likewise decision to explore multiple defects will depend upon their nature, the patient's symptoms, and the surgeons' clinical judgment.

In selecting cases of suspected herniated disc for myelography we have adhered to a conservative policy. Only those patients with intractable, characteristic symptoms of herniated disc, who have not responded satisfactorily to conservative orthopedic measures have been subjected to this diagnostic procedure. No patients have been operated upon without it. We believe that this is sound policy. As a result we were dealing with relatively severe cases and this may explain in part the high incidence of multiple herniations.

It should be emphasized that although the removal of multiple ruptured discs will usually relieve acute symptoms, heavy work is prob-

ably more likely to precipitate postoperative symptoms in this group than in patients who have required the removal of only a single disc. The fact that multiple discs are relatively common therefore only emphasizes the complexity of the problem.

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## METASTATIC HYPERNEPHROMA OF THE THYROID GLAND

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THE rarity of metastases to the thyroid gland from primary malignant foci elsewhere in the body is well recognized.

Willis in 1931 reviewed the literature in reference to metastatic tumors of the thyroid. He collected 47 cases and added 10 more of his own. His cases were taken from 170 consecutive autopsies in patients who died of malignant disease—an incidence of 5.9 per cent. Other series of autopsies in cases of extensive carcinoma which he collected gave percentages varying from 1.5 (15) to 3.1 (7). Rice found, in a series of 89 autopsies on patients who died from malignant tumors, 9 or 10 per cent of the thyroids showing metastatic tumor cells. These could be seen grossly in 5 cases and were found only on careful microscopic sectioning in the other 4. He stressed the need for more careful study of the thyroid gland in such autopsies. Mayo and Schlicke, in 1941, reviewed all the cases of metastases to the thyroid which had been encountered at the Mayo Clinic. They found 19 cases and in 3

the diagnosis was made from thyroid specimens removed at operation. Two of these cases were metastases from hypernephromas and one from a carcinoma of the rectum. Seven cases had thyroid abnormalities noted before death and the remaining 9 cases were encountered during routine autopsy examination. The total number of autopsies done was not given, but in more than 45,000 cases in which thyroidectomy was performed only 3 metastatic lesions were found.

Explanations for the infrequency of metastases in the thyroid have been sought in 2 directions; one group postulating that the very rich arterial supply inhibits the lodgment of emboli in the gland, while others were of the opinion that the rarity is due to chemical factors which hinder metastatic growth. Paget spoke of some tissues which he considered "congenial soil" for malignant tumors. The high oxygen and high iodine content of the gland may be factors which inhibit the development of malignant cells. In contrast the relatively low oxygen saturation of liver tissue may predispose to the frequency of neoplastic spread to this organ. Warburg has





Fig. 1. A photomicrograph from the original hypernephroma. The tumor was removed when the left nephrectomy was performed in 1936. The cellular structure is similar to that seen in Figures 3 and 4.

pointed out that tumor cells can grow at a relatively low oxygen tension.

Willis concluded that chemical factors largely explain the scarcity of metastatic lesions in the thyroid. He found that in several of his cases adenomatous and fibrous changes in the thyroid had preceded metastases and he felt that the lower oxygen and iodine content predisposed to the establishment of these metastases. Similarly, Mayo and Schlicke found underlying adenomatous changes in 12 (and perhaps in 4 others) of their 19 cases. The thyroid in the case presented here also showed the same underlying pathology. It seems to us, however, that such changes in the thyroid gland tend to support the theory that the rich blood supply of the organ hinders the lodgment of tumor emboli, since fibrotic areas and degenerating adenomas probably have a reduced blood supply compared to normal thyroid tissue, so that the tumor emboli may be deposited more readily in these areas. It also seems probable that the sieve-like action of the lungs is an important factor in decreasing the number of tumor emboli which might otherwise lodge in the thyroid. Willis further found in his series that malignant melanomas and primary lung carcinomas, although relatively uncommon tumors, were found to have metastatic foci in the thyroid in a proportionately higher num-

ber of cases. He concluded from the data that different types of tumors possess different intrinsic capacities for establishing metastases in the thyroid. Miller and Jones, however, collected 808 cases of primary lung cancer and found only 8 cases in which there were metastases to the thyroid, an incidence of only 1 per cent.

A review of the literature reveals that only 15 proved cases of metastatic hypernephroma of the thyroid have been reported. Since this lesion is of such rarity it seems justifiable to report an additional case.

According to H'Doubler the first 5 cases were reported in the European literature. These were by Lubarsch, in 1894, Kodzubowski, in 1904, Pistocchi, in 1922, Rost, in 1912, and Klose, in 1925. The first 3 cases were recognized clinically, but the last 2 were discovered on routine autopsy. Since 1931, 10 additional ones have been reported, 9 in the American literature and 1 in the French literature. Kolodny, in 1926, reported a case which he considered metastatic hypernephroma of the thyroid with an accompanying clinical picture of exophthalmic goiter, but considerable doubt has arisen in regard to the case. The gland was removed and found to contain many circumscribed yellowish white nodules which Kolodny believed on microscopic examination to be metastatic hypernephroma. The patient, however, remained in good health with relief of her symptoms and no primary tumor was found. This case on further analysis probably was not a metastatic hypernephroma and, therefore, is not included in the group of cases reviewed here, especially since Simpson, in 1926, reported 8 cases out of a group of 55 malignant thyroid glands in which he found microscopically groups of cells that simulated hypernephroma. He concluded that Kolodny's case represented this type of tumor.

Willis, in 1931, reported the first authentic case in the American literature of metastatic hypernephroma of the thyroid gland. The condition was discovered on postmortem examination. The thyroid gland was found to show fibrosis and parenchymatous atrophy. Pemberton and Bennett, in 1934, reported 7 cases from a series of 45,421 surgical thyroid

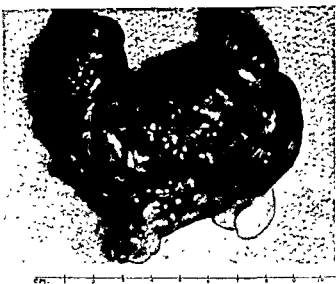


Fig. 2. a, left, A photograph of the entire thyroid gland removed in one piece at operation on April 13, 1944. Note the lobulated appearance of the specimen. b, A photo-

graph after section of the specimen to show the metastatic nodules of tumor tissue throughout the substance of the thyroid gland.

specimens removed at the Mayo Clinic between 1892 and 1932.

H'Doubler, in 1936, reported 2 cases. The first, a man aged 59 years, presented the classical symptoms of hyperthyroidism with a basal metabolic rate of plus 46. One year previously he had noted bloody urine. Physical examination showed an enlarged right lobe of the thyroid gland. This was removed at operation and was found to be a canary yellow nodule, which on histologic examination proved to be typical of hypernephroma. The patient died 3 years later from generalized metastatic renal cell carcinoma. The second, a woman aged 73 years, complained of choking spells and a goiter. Six years before, a hypernephroma of the right kidney had been removed. She had noted a lump in her thyroid gland 3 years later which had gradually increased in size. Physical examination showed an enlarged, firm right lobe of the thyroid gland. An operation was performed, at which the right lobe, the isthmus, and an accessory nodule were removed. One and a half years later a nodule developed in the left lobe. She died 4 years after the operation of generalized metastases.

Caylor and Caylor, in 1936, reported 1 case, a man aged 59 years, who had had a transperitoneal nephrectomy for hypernephroma. Thirteen years later, at operation, an inoperable metastasis was found in the

thyroid gland. He was given roentgen therapy with some improvement.

Weiskittel, in 1937, reported 1 case among 10,000 thyroidectomies at the DeCourcy Clinic. The patient, a man aged 60 years, 8 years previously had had a right nephrectomy for a hypernephroma. He later noted a painless swelling of the neck. Physical examination revealed an enlarged, firm thyroid gland. A basal metabolic rate was plus 32. At operation a large metastatic renal cell carcinoma was removed. The wound was packed open because of extensive bleeding. He was given postoperative roentgen therapy but died 9 months later.

Fey and Truffert, in 1938, reported a case that had succumbed to extensive metastatic hypernephroma and necropsy revealed involvement of the thyroid gland. It is of interest that 16 years before a thyroid adenoma had been removed.

Welti and Huguenin, in 1939, reported 1 case of metastatic hypernephroma in a series of 88 cases of thyroid malignancy. The patient presented mild symptoms of hyperthyroidism. One kidney had been removed 10 years before for carcinoma. The patient died later of extensive metastases.

Long and Black, in 1945, reported a third case from the Mayo Clinic. The patient, a man aged 59 years, complained of a slowly enlarging goiter of 1 year's duration. Eight



Fig 3. A photomicrograph from one of the metastatic nodules from the thyroid gland. Note the similarity in appearance between the cellular structure of this specimen and the ones shown in Figures 1 and 4.



Fig 4. A photomicrograph from biopsy tissue from hypernephroma of right kidney removed September 22, 1944. Note similarity of cellular structure to that of original tumor (Fig. 1) and thyroid metastasis (Fig 3).

years previously a nephrectomy had been performed for a hypernephroma. Physical examination revealed a diffusely enlarged thyroid gland of soft consistency. A resection of both lobes and the isthmus was performed. The histologic examination revealed metastatic hypernephroma. Postoperative roentgen therapy was administered.

#### CASE REPORT

Frank C., a man aged 55 years, was admitted to The Baker Memorial Hospital on March 30, 1944, complaining of swelling in the neck, ease of fatigability and weight loss, of about 6 months' duration.

About 6 months before entry following a severe upper respiratory infection, he noted the insidious onset of increasing ease of fatigue and was troubled with persistent left frontal headaches which were aggravated on lying down. He lost his appetite, became "nervous and irritable" and about 4 months before entry began to note a slowly increasing swelling in his neck. His weight fell from a normal of 204 to 186 pounds. During the month previous to admission the swelling increased rapidly and he began to have a "scratchy" feeling in his throat on swallowing but had no real hoarseness or dysphagia. He noted no tremor, palpitation, or increased prominence of the eyes.

Because of the cervical tumor, he was studied first in the hospital in which he worked. There it was found that his blood examination was within normal limits; his blood pressure was 116 systolic and 70 diastolic. His basal metabolic rate was minus 3. The blood cholesterol was 140 milligrams per cent. A barium enema, a cholecystogram, and a gastro-

intestinal series of roentgenograms were all negative. Intravenous pycelography showed an enlarged right kidney. No shadow was seen on the left which was consistent with his left nephrectomy 9 years previously. After the completion of these studies he was referred to The Baker Memorial Hospital for further study and treatment with a presumptive diagnosis of thyroiditis.

The patient was born in Portugal, coming to the United States at the age of 13 years. For several years he worked at varied occupations but for the past 26 years he had been a mechanic in a hospital. He had been married 31 years; his wife was living and well. They had had one child who died at birth. Nine years before this hospital admission a left nephrectomy was performed by Dr. C. L. Deming at the Willam Backus Hospital in Norwich, Connecticut. A renal cell carcinoma of the hypernephroma type was diagnosed pathologically (Fig. 1). He recovered uneventfully from the operation and, until his present illness, had enjoyed good health. He had had no other operations or serious illnesses. His system review was negative except for chronic sinusitis and a slight chronic nonproductive cough. He had occasional nocturia, but noted no hematuria or frequency. He smoked about ten cigarettes a day but did not use alcohol.

His family history was noncontributory and he knew of no familial incidence of cancer, tuberculosis, heart disease, diabetes, thyroid disease, or allergies.

Examination showed a well developed and nourished man with an obvious enlargement in his anterior cervical region, which was consistent with a symmetrical, diffusely enlarged thyroid gland with a slightly irregular outline. The gland was firm, but not stony hard and moved normally on swallowing. No regional nodes were palpated and no bruit was

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present. The patient showed no signs of hyperthyroidism or hypothyroidism. Examination of the abdomen revealed a movable, nontender, rounded mass in the region of the right kidney, which descended to the level of the iliac crest on respiration. Physical examination was otherwise negative.

Blood count was 4.54 million; photohemoglobin, 13.2 grams per cent; white blood count, 8,600; the blood smear showed normal platelets, red and white blood cells. Urine examination showed specific gravity 1.008 to 1.020; one plus albumin; negative sugar; sediment, 0-20 red blood cells, 3-20 white blood cells and an occasional hyaline cast per cent in 2 hours. Blood chemistry examinations showed: nonprotein nitrogen, 27 milligrams per cent; fasting blood sugar, 119 milligrams per cent; cholesterol 266 milligrams per cent; calcium 8.8 milligrams per cent; phosphorus, 3.3 milligrams per cent; serum protein 7 grams per cent. The prothrombin time was normal and the blood Hinton test was negative. The basal metabolic rate was minus 3. Roentgen examinations revealed the following: The chest plate showed a slightly enlarged heart in the region of the left ventricle, but no evidence of substernal goiter. Retrograde pyelograms showed the right pelvis well outlined. The infundibula were narrowed with an appearance of marked general enlargement with a slightly lobular contour. A diagnosis of congenital polycystic kidney was considered to be the most likely diagnosis from study of these roentgenograms.

**Diagnosis:** Malignancy of the thyroid gland.

On April 13, 1944, operation was performed. Endotracheal ether anesthesia was used. Through a transverse collar incision, an enlarged vascular thyroid gland was exposed. Biopsy specimens showed yellowish tissue, suggestive of hypernephroma. The right lateral thyroid vein was found to be filled with tumor-like tissue and accordingly it was believed that the thyroid enlargement was due to malignant growth, so a total thyroidectomy was performed. The recurrent laryngeal nerves and two parathyroid glands were visualized and preserved. The tumor was not adherent except over the cricoid cartilage. No enlarged nodes were seen or felt along the carotid sheaths and the lateral thyroid veins were ligated proximal to any obvious tumor; hence a radical neck dissection was not felt indicated. The wound was closed in layers without drainage. Catgut ligatures and sutures were used for hemostasis and wound closure.

Pathological examination of the specimen showed a 7 by 2 by 1.5 centimeter gland which weighed 72 grams. It was made up of round, soft, lobulated yellow-orange nodules measuring 0.5 to 2.0 centimeters in diameter. The right middle and inferior thyroid veins were filled with similar tissue (Fig. 2). The thyroid tissue between the nodules was red-

brown, firm and meaty. Microscopically was consistent with renal cell carcinoma.

The immediate postoperative course was uneventful except for slight transitory response to peroral administration of gluconate. Postoperative roentgen ray of the cervical region was not advised by the department, so the patient was discharged hospital on April 26, 1944.

Following his discharge he developed which responded to the administration extract. He remained fairly well at home severe headaches and pains in his cerv.

He was readmitted to The Baker Hospital on September 13, 1944, 4½ m his first discharge, complaining of an incrt and pain in the right side of his abdomen examination showed the patient still in a of nutrition. His thyroidectomy scar healed. No evidence of recurrence of the found in his neck. The mass in his right enlarged considerably.

Laboratory studies at this time showed count, 3.85 million; photohemoglobin, per cent. Urine examination revealed gravity, 1.012; negative albumin and ment, occasional white blood cells and no cells. Blood chemistry examinations revealed: protein nitrogen, 33 milligrams per cent; 6.8 milligrams per cent; phosphorus, 5.2 per cent and serum phosphatase, 2 units (1 Roentgen examination of the chest ar spine was negative.

On September 22, 1944, with patient u anesthesia, the right kidney was exposed James D. Barney. A large renal tumor that could not be removed. A biopsy specimen taken which showed renal cell carcinoma.

The postoperative course was uneventful given palliative roentgen-ray treatment his right kidney to a total of 1200 r each t posterior, and lateral fields.

The latest report from the patient was following discharge. At that time he stat felt well and wished to return to work.

This case, as far as can be determined 16th case of metastatic renal cell carcinoma the thyroid to be reported in the 1. Several of these, however, were 1 routine autopsy and undoubtedly tl been others which have not been Those cases in which the goiters cognized clinically and upon which was performed are of extreme interest condition must be considered as a p in the differential diagnosis of thyroid especially in those patients who l viously had surgery performed for 1 growth.

The question of the manner in which metastatic emboli reach the thyroid from the kidney is still obscure, since if it is by the blood stream these organs are separated by the extensive capillary bed in the lungs. The persistence of a patent foramen ovale is one possibility whereby tumor cells could by-pass the pulmonary circulation to produce a paradoxical metastasis. The work of Batson has postulated the vertebral system of veins as another pathway by which such metastases may travel without going through the lungs. This also could be an explanation of the lack of pulmonary metastases in this and similar cases.

In the case reported the fact that a hypernephroma was found in the right kidney 9 years after a left nephrectomy had been done for a similar type of tumor, is of interest. This could be interpreted as a case of bilateral primary hypernephroma, although it is likely that the tumor in the right kidney was a metastasis from the original lesion. Forsythe, in 1942, reported a case of bilateral hypernephroma and found only 6 other cases, some of which were probably metastatic lesions rather than separate tumors. Beilin and Neiman in the same year reported another case and stated that direct metastasis from one kidney to the opposite is unusual. The origin of the thyroid metastases in the case reported may have been from either the right or left kidney, since the microscopic examination of the 3 specimens is identical. In view of the lapse of 9 years between the removal of his left kidney and the discovery of thyroid metastases, it seems most likely that they arose from existing tumor of the right kidney. The rapidity and the recentness with which the enlargement of the thyroid gland manifested itself tend to substantiate this view.

#### SUMMARY

A case of metastatic hypernephroma to the thyroid gland, the 16th proved case in the

literature, is reported. It is the first case observed in the records of the Massachusetts General Hospital. It is unusual in that the first sign of metastases occurred 9 years after a left nephrectomy for a hypernephroma and coincidental with the discovery of a similar tumor involving the right kidney.

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# MALFORMATION OF THE ANUS AND RECTUM

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FROM December 1936 to December 1945, there were 20 patients with malformation of the anus and rectum admitted to Doernbecher Hospital. Of these, 11 were males and 9 were females. The incidence of all admissions for this period of time was 0.14 per cent.

The probable cause of this condition is some arrest or abnormality, which takes place in the 7th or 8th week of embryonic life. The details of these abnormalities and embryonic development have been clearly discussed by Ladd and Gross.

There are four distinct types of imperforate anus, ranging from simple stenosis to complete atresia of the anus and rectum. Figures 4a, 5b, 6a, and 7 are examples of these types.

The most common type in our series (as seen in Fig. 5b) was an absence of the anal opening in which the blind rectal pouch was only  $\frac{1}{2}$  to 2 centimeters from the perineal dimple. We had 6 such cases in our series. These were most amenable to surgery and in every case good results were obtained.

In most of the cases in our series of complete absence of the rectum, where the rectal pouch was 2 to 3 centimeters from the perineal dimple, an associated rectovaginal fistula was present with a fistulous tract extending from the rectal pouch to the vagina near the posterior fourchette.

Seven of the 20 cases were of this type. In 5 of the 7 cases repair was made by dissecting away the fistulous tract and bringing the rectal pouch down to the anal dimple by cutting through the sphincter and making a new outlet. In 1 case repair was not made and in 1 other case a colostomy was necessary, then later, the rectal pouch was brought down to the anal dimple and the colostomy closed.

There were 2 cases of anal stenosis in which obstructive symptoms were outstanding and dilatation rather than surgery were the only procedures necessary (Figs. 6 and 6a).

One patient (L. W. No. 141451) had complete absence of the rectum—yet the perineal dimple had a deep indentation of approximately 2 centimeters (Fig. 4a). The rectal pouch was so far (3 centimeters) from the perineal dimple that the rectum could not be brought down and a colostomy had to be done. When the distance was 3 centimeters or over from the gas-filled rectum to the anal dimple, colostomies were done. There were 4 such cases in our series.

There are certain practical points to be stressed as a result of study of these cases.

The importance of determining in advance the distance between the perineum and the blind end of the bowel should be emphasized because the perineal dissection should not be persisted in, in cases in which the bowel is further than  $2\frac{1}{2}$  centimeters from the perineum. The best method of determining this distance is described by Wangenstein and Rice. Anteroposterior and lateral x-ray films are taken with the baby in the upside down position with a metal marker in the anal dimple. If 8 hours have elapsed since birth, presence of gas in the rectal pouch will show the distance of the blind end of the bowel from the perineum. If the distance is less than  $2\frac{1}{2}$  centimeters the bowel may be readily brought down to the perineum in most cases. If higher, perineal dissection may be attempted but if one is unsuccessful in finding the lower end of the bowel, the dissection should not be prolonged and colostomy should be done.

Any case of rectovaginal fistula or rectoperineal fistula can be brought down from below. This is not true of rectovesical or rectourethral fistulas—the fistula in these latter cases should be repaired later in life.

A noteworthy point is the frequent association of other congenital deformities with these deformities of the anus and rectum. The following table shows the different abnormalities encountered in these cases: cataracts, 2; strabismus, 1; rectovaginal fistula, 7; rectovesical fistula, 1; congenital heart, 3; atresia of esoph-

agus, 1; hypospadias, 1; absence of radius, 1; absence of urethra, 1; undescended testis, 1; megalocolon, 1; double pelvis, 2; ectopic kidney, 1; hydroureter, 2; umbilical hernia, 1; absence of digits, 2; absence of external ear, 1. The only immediate postoperative death in this series was a child with absence of the urethra as well as the anus. Four other patients who died at dates ranging from 3 months to 2 years following surgery all had anomalies of the urinary tract.

The following are abstracts of the cases in our series.

#### CASE REPORTS

R. H., Case No. 138372, was born April 6, 1944, and admitted to Doernbecher Hospital April 7, 1944 for surgery. This child was born with an imperforate anus. On April 8, 1944 patient was taken to surgery. There was an unopened mucus-like channel (Fig. 1) running from the region of the imperforate anus to the base of the scrotum. This was tube-like in character, very narrow, and was filled with inspissated meconium. It was dissected up from the scrotum and an incision made at the anus in the anterior posterior direction and a large quantity of meconium was evacuated. Several other abnormalities were found in this child. Fingers were peculiar. There was a harsh systolic murmur at the apex. There was a small tumor on the external ear. The child was discharged on April 12, 1944. Now child has excellent sphincter control and is in good condition.

N. W., Case No. 123194, 3½ week old child, was admitted to the hospital on November 24, 1941 with a congenital absence of the anus and a rectovaginal fistula (Fig. 2). The fistula had apparently been sufficient for fecal outlet as the child had no history of obstruction and had been developing normally since birth. The mother had been cleaning the bowel out by catheterizing the fistulous tract. Physical examination revealed a well nourished child, whose only abnormality was of the perineum and genitalia. There was no anus present; just an anal dimple where the opening should be. There was a fistulous tract just inside the posterior fourchette which apparently communicated with the rectal pouch. Anteroposterior and lateral x-ray films of the pelvis, after injection of barium through a rectovaginal fistula by means of a rubber catheter, were taken. The rectum was well visualized, ending in a blind pouch, which is approximately 2 centimeters from the imperforate anus which is marked by small opaque marker. It was the opinion of the surgical staff that surgery should be deferred until a later date because of the mechanical difficulty involved in such a small child. Patient was discharged and the mother was instructed to keep the stools soft with mineral oil. Patient returned July 25, 1943, was taken to surgery where an incision was made through the anal dimple

and through the sphincter muscles up to the levator. Dissection was then carried around the rectum on each side and when this was complete the mucous membrane at the rectovaginal junction was incised and the entire anal rectal canal was transplanted to the perineum. The vaginal mucosa was repaired. The child made an uneventful recovery except for a retrovaginal defect which remained. The child's hospital stay was 15 days, being discharged on August 13, 1943. Further repair to be considered in the future. Later repair was done with satisfactory closure of the rectovaginal opening. Since this time patient has been asymptomatic.

K. P., Case No. 129015, 3 week old white female, entered Doernbecher Hospital January 4, 1943 with imperforate anus and a rectovaginal fistula (Fig. 2). The child was taken to surgery where the rectovaginal fistula was dissected and closed; and the distal end of the rectum was brought through the anal ring and the mucosa sewed to the skin. The rectal pouch was about 2 centimeters from the anal dimple. The child had a very stormy course postoperatively, but apparently recovered and had good sphincter control. However, on August 9, 1943 the child was admitted to the hospital with a terminal urinary tract infection. Autopsy showed bilateral hydroureters and hydronephrosis with a suppurative pyelonephritis.

D. E., Case No. 127337, 4 day old white male, entered the hospital on July 5, 1942 because of an imperforate anus. Examination revealed a well nourished white male infant. The abdomen was quite distended and taut. No hernia was detected. No abdominal mass was palpable. The anus was found to be imperforate. Remainder of the examination was essentially negative. X-ray examination revealed the heart and lungs normal. The abdomen revealed a large amount of free gas in the peritoneal cavity with the shadow of the small bowel containing air clearly visible (Fig. 3a). On August 7, 1942 the child was taken to surgery. The abdomen was opened whereby a large amount of air came through the incision. A large amount of yellowish material with fibrin flex was present in the abdomen. In the lower right quadrant of the abdomen there was a distended, necrotic portion of bowel. On examination this section of bowel revealed a small rupture through which much meconium has passed into the abdominal cavity. A rubber drain was passed beneath the bowel at this point and was delivered to the surface where it was exteriorized and the abdomen closed. The child showed a slow gradual improvement with a slow progressive weight gain. On August 7, 1942 barium meal was given. The esophagus, stomach, and duodenum were normal. Also the barium was injected in the distal loop of the colostomy. The roentgenographic findings were very suggestive of an occlusion or stenosis of the distal sigmoid approximately 4 centimeters above the anus (Fig. 3b). Inspection of the proximal loop of the colostomy revealed it to be sigmoid colon. At the time of discharge on August 24, 1942 the child

was showing a progressive weight increase, weighing 7 pounds 13½ ounces. His general condition was quite good. The child was readmitted on October 4, 1942. Since his discharge following surgery for imperforate anus he seemed quite well until 4 days before when he began to vomit. He had had no difficulty with the colostomy opening since his discharge. Physical examination at this time revealed a patent and functioning colostomy opening. The tissue around this area was redundant and inflamed. The child went rapidly downhill and died on October 10, 1942, 3 months after colostomy. Autopsy findings revealed: atresia of the lower rectum and anus; double-barrel colostomy, functioning, of the left lower quadrant; bilateral interstitial nephritis and left pyelitis and hydronephrosis.

D. H., Case No. 68466. This child entered the Doernbecher Hospital for the first time at the age of 3½ months. Since birth patient had had a rectovaginal fistula with imperforate anus (Fig. 2). The child returned for surgery at age of 4½ years. At the operation a rectovaginal fistula was dissected. The vaginal opening was closed and the rectal pouch brought to the anal dimple and the mucous membrane was sutured to the skin. The rectal pouch was 3 centimeters from the anal dimple. The child made an uneventful postoperative recovery and has had normal sphincter control. Dilatations were continued at home; the child has been seen in out patient clinic since 1941 and has had no further trouble.

A. J., Case No. 105727, 8½ hour old white male entered the Doernbecher Hospital with an imperforate anus. X-ray films were taken by the Wangenstein-Rice method and the rectum appeared to be 3 centimeters from the anal dimple (Fig. 4a). The child also had a hypospadias. Colostomy was done on January 13, 1940 and the child recovered uneventfully, yet, 1 month later the child returned to the hospital with a high fever and a methylene blue injection was given through the distal loop of the colostomy and it appeared in the urine in 2 hour proving the presence of a rectovesical fistula. The child was discharged and given a poor prognosis. Surgery was impossible due to the child's poor condition at this time. The child was followed for 1 year in the out patient clinic with no improvement of the pyelitis which he contracted shortly after the second hospital admission. The child did not return and further prognosis of the case is not known.

S. K., Case No. 141466, 7 day old white female entered the Doernbecher Hospital on October 9, 1944, one of twins, with only a dimple at the anus. The child had an opening between the vagina and the anus (Fig. 2). A repair of the imperforate anus was done; the rectovaginal fistula was dissected out and removed and the mucous membrane was sutured to the skin at the anal dimple forming an anal orifice. The rectal pouch was approximately 2½ centimeters from the anal dimple. The child made an excellent recovery and was discharged on October 30, 1944. Since this time the child has been asymptomatic with good sphincter control.

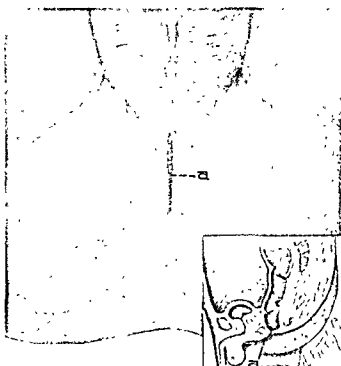


Fig. 1. Unopened channel running from the anal dimple to the base of the scrotum. This was filled with inspissated meconium.

L. H., Case No. 112704, 1 day old white male was brought in with an imperforate anus. X-ray films on admission showed the air column in the rectum to be within 1½ centimeters of the anal dimple (Fig. 5 and 5a). The child was taken to surgery where the rectal pouch was opened from a perineal incision. A large amount of meconium was expressed. The cutaneous margin of the rectal pouch was unable to be sutured completely to the anal opening and a rubber tube was inserted. This was kept dilated daily and thus a normal opening was established and the child was discharged and has remained asymptomatic.

B. M. C., Case No. 106001, 3 day old white female entered Doernbecher Hospital on January 17, 1945

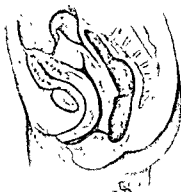


Fig. 2. Drawing of the rectovaginal fistula, which was present in 7 cases of our series.





Fig. 3. a, Showing pneumopentoneum in case of imperforate anus

with a rectovaginal fistula and absence of anus (Fig. 2). Distance from rectal pouch to the anal dimple is unknown. The child was not treated at this time for the imperforate anus and was discharged. The child also had atresia of the esophagus, incomplete.

D. A. F., Case No. 01697, 3 day old white male entered Doernbecher Hospital on September 19, 1938 with an imperforate anus. X ray films revealed a gas bubble to be just skin thickness from the rectum (Fig. 5a). The child was taken to surgery where the skin overlying the anal dimple was opened and the rectum was opened. A large amount of meconium was released. The anus and rectum were dilated twice daily. The child made an uneventful recovery and was sent home. The mother was instructed to dilate the anus daily for 6 months. The child has had no complications since.

R. G., Case No. 123004. This child had an imperforate anus at birth on May 8, 1938. On May 9, 1938 a colostomy was performed. The child had apparently carried on a normal activity at that time until the admission on November 15, 1941, at which time x-ray films of the pelvis were taken after injection of lipiodol through a distal colostomy loop with an opaque marker pressed against the anus which was imperforate. The distal rectum was absent and there was a distance of 4 centimeters from the opaque



Fig. 3. b, Injection of colostomy with barium—no filling below the sigmoid

marker to that portion of the rectum which was filled (Figs. 4 and 4a). At the operation an anterior posterior incision was made in the midline of the perineal floor, extending from the scrotum backward almost to the tip of the coccyx. The anal sphincter muscles were partially split in order to give adequate exposure, and it was necessary to bisect the perineal body in order to reach the rectal pouch. The latter was located about 3 to 4 centimeters above the anal dimple. The pouch was then carefully freed from adjacent tissues and structures. The rectal wall was then fixed to the subcutaneous tissue with interrupted cotton stitches after the pouch was freed sufficiently to allow it to be brought to the perineum without tension. The pouch was opened into and the lumen demonstrated by the presence of the rectal tube which had been placed in the colostomy before surgery. The lining of the pouch was then sutured to the skin of the perineum, leaving an opening which was sufficiently large to easily admit the big index finger. Then a side-to-side anastomosis of the two loops of colon was done. The abdomen was then closed in layers around the colostomy. In attempting to dissect the dense adhesions free from the colostomy the bladder was inadvertently opened into, but im-



Fig. 4. X-ray film with lipiodol injected into the distal colostomy loop showing end of bowel a great distance from perineum.

mediately closed. After surgery a retention catheter was left in place. Colostomy was closed on April 1, 1942. After surgery child made an uneventful recovery. During the last 2 years he has had fair bowel movement with fair sphincter control. The anus has been dilated at intervals.

L. B., Case No. 146510, 2 day old white female, was admitted to the Doernbecher Hospital on July 7, 1945 with the chief complaint of imperforate anus. The patient vomited mucus 1 hour after birth and has vomited all offerings by mouth. Upon attempting a rectal, the nurse discovered the anus to be closed. No other congenital abnormalities were noted. Anteroposterior and lateral x-ray films were taken (Figs. 5a and 5b), and showed air outlining the rectum which extends down to within about 1 centimeter of the dimple of the anus. In the lateral film the direction of the rectum is normal, the blind end extending posteriorly. The pouch is broad with smooth borders. Patient was taken to surgery at 3:00 p.m. on July 7, 1945. Under ether anesthesia the imperforate anus was repaired. The septum which was between the rectum and the anus was divided and the mucus membrane of the rectum was sutured to the mucus membrane just internal to the sphincter. Patient passed considerable gas and meconium and was returned to the ward in good con-



Fig. 4. a, Drawing of the defect shown in x-ray film in Figure 4.

dition. Patient was discharged July 15, 1945 asymptomatic. The anal outlet was to be dilated by home physician to keep the opening adequate. The patient has been asymptomatic since.

A. P., Case No. 140517, 16 month old white male entered the Doernbecher Hospital on August 11, 1944 for his first admission. He was treated at this time for chronic sinusitis and a kidney infection. He had had an operation for an imperforate anus at the age of 4 days (Fig. 5a). On the present examination the child has an extremely small stenotic anus which will not admit the tip of the little finger. The patient also had a megalocolon from obstruction from massing of feces in the colon. Cystograms and intravenous pyelograms disclosed two kidneys on the left side. One is normal and one showed a marked nephrosis and hydronephrosis. The child gave the impression of having renal rickets and renal dwarfism, with a low blood calcium of 7 milligrams per cent. On August 22, 1944 the child had a manual dilatation of the rectum and the large bowel was cleaned out. He was discharged August 23, 1944. On September 25, 1945 the child was readmitted to the hospital—dead on arrival. Autopsy revealed extensive bronchopneumonia; agenesis of the right kidney; double left pelvis and ureters with hydronephrosis and megaloureter; megalocolon; undescended left testis.

T. T., Case No. 149691, 4 month old white male entered the Doernbecher Hospital on August 21, 1945 with the chief complaint of constipation and vomiting. Patient was well until 4 days previous to admission when he became very irritable, did not have any bowel movements and vomited several times. The physical examination was essentially negative except for a distended abdomen which had visible peristalsis and tympany. The rectal sphincter was very tiny. It would not admit the finger. Otherwise, the physical was essentially negative. Hematology, tuberculin, and serology were negative. Barium enema revealed a large redundant sigmoid with anal stenosis (Figs. 6 and 6a). The child was given daily anal dilatations which resulted in relief



Fig. 5.

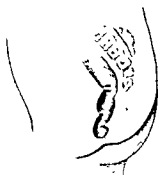


Fig. 5b.

Fig. 5 a, Showing Wangenstein and Rice method of determining where the rectal pouch ends, by taking anteroposterior and lateral x-ray films with baby upended and a metallic marker at the perineal dimple. b, Drawing of type of defect shown in Figure 5a of which type there were 6 cases in our series.

of distension and partial obstruction. Follow-up care showed no further bowel obstruction and after



Fig. 5a.

several months of anal dilatation, he had had no more symptoms.

L. W., Case No. 141451, 6 day old male infant entered Doernbecher Hospital on October 7, 1945 for relief of imperforate anus, also for a deformity of the right forearm and genitalia. Physical examination revealed an enlarged heart with soft, systolic murmur heard at the apex. Imperforate urethra, atresia of the anus, absence of the right radius and right first metacarpal. X-ray films were taken showing an area about 3 centimeters from the air filled rectum to the perineal dimple. Child was taken to surgery on October 8, 1945 where an attempt was made to bring the rectum down to the perineum. The rectum was not found but the bladder was exposed, opened, and the edges sutured to the anal opening. Due to the distance of 3 centimeters from the perineal dimple to the abdominal cavity, the bowel could not be brought down, so a left rectus incision was made into the peritoneal cavity. The sigmoid colon was exteriorized and a double-barrel colostomy was established. No external urethral opening could be found. The colostomy was opened and a small amount of meconium came out. The bladder was brought down because of possible contamination with colostomy, suprapubic drainage was contraindicated. The child did not respond well after surgery and expired.

P. A. R., Case No. 117417, 6 week old white female, entered Doernbecher Hospital on March 7, 1941 with a stenosis of the anal opening (Fig. 6a). The rectum was dilated and the dilatations were continued for several months after which the child remained asymptomatic.

M. F. H., Case No. 77635, 4 hour old white female entered Doernbecher Hospital on July 26, 1939 with an imperforate anus and a rectovaginal fistula since birth. A barium enema was given through the rectovaginal fistula showing a greatly dilated rectum. The rectum was found to be 3 centimeters from the anal dimple. A colostomy was done at this time. On June 10, 1940 a repair of the rectovaginal fistula was done. The fistulous tract was excised and the rectum was brought out to the anal dimple and the mucous membrane was sutured to the skin. Permanent colostomy was not made since the child had a fairly adequate anal opening with sphincter control. The child did not come in for follow-up care.

A. D. P., Case No. 95440, 1 day old child, was admitted to the Doernbecher Hospital on January 15, 1939 with the chief complaint of imperforate anus. He was a full term, well developed baby weighing 10 pounds. There was a small sinus tract which appeared to be filled with meconium extending out from the anal dimple. By pressure over this area meconium passed back into the rectum. On January 16, 1939 a small incision was made in this tract and a probe passed through it into the rectum. The tract was dilated gently with a hemostat. A large amount of meconium was expelled. This tract was dilated gently every day to keep the anal ring open. There was good sphincter tone present. It functioned fairly well until 1 year of age at which time the child was again admitted to the hospital complaining of abdominal pain and vomiting. At this time the child was well developed and well nourished. The anus was very small, partially admitting the tip of the little finger. The rectum was filled with fecal material. The child was taken to surgery at this time and the sphincter ani was dilated under ether anesthesia. A large amount of dry fecal material was removed. The child's rectum was dilated daily up to a No. 32 French catheter. Since this time the child has been fairly well.

R. E. K., Case No. 102290, 3½ month old white female, entered the Doernbecher Hospital on September 6, 1939 for surgical correction of an imperforate anus. The child has been having fairly regular bowel movements through a rectovaginal fistula (Fig. 2). The child has never vomited and seems to be in every other way a normal child. Physical examination revealed a well nourished, well developed girl. No anus is present, but a small dimple can be seen on the perineum. Urinalysis revealed a three plus pus. Hematology showed an 86 per cent hemoglobin and 17,000 white blood count. A new rectal outlet was created to correct the imperforate anus. The rectal pouch was 3 centimeters from the perineal dimple. The rectovaginal fistula was not closed at this time. The child was discharged asymptomatic.



Fig. 6.



Fig 6a.

Fig. 6. X-ray film showing anal stenosis and dilated sigmoid. a, Drawing of type of lesion shown in Figure 6. (Two of our series were of this type).

The early recognition of these malformations, especially those with complete obstruction, is important. Inspection at the time of the delivery will reveal almost all the abnormalities, except the defect such as in Figure 7. In this type of case the external opening ap-

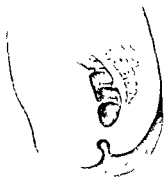


Fig. 7. Drawing showing pathology in patient who appeared to have normal rectal opening

appears normal and the rectal temperature can be taken, but no meconium passes.

The operative details in these cases are as follows: The child is placed in the prone position, with the hips elevated, and an incision is made in the midline in the region of the anal dimple in the anterior-posterior direction. The external sphincter is thus divided in the midline and its function not destroyed. The external sphincter is usually present in these cases, inasmuch as its mesenchymal origin, embryologically, is different from that of the rectum itself. Thus anal control is usually good. When the bowel is any distance from the perineum, it is freed by dissection sufficiently to bring it down and suture it to the skin between the lateral halves of the sphincter muscle, with closure of the skin anteriorly and posteriorly to the rectum.

In the cases of rectovaginal fistula, it is easy to make the mistake of not bringing the rectum far enough posteriorly. In these cases the area of the rectum, where the fistula exists, is best brought to the outside, or otherwise, the fistula may recur. In all of these cases tension must not be present in suturing.

The cases of rectovesical fistula and rectourethral fistula must not be repaired until the child has attained some growth.

The postoperative care of the rectal opening depends upon careful, gentle dilatation with a bivalve nasal type speculum. This should be kept up at occasional intervals until the anus admits the examining finger. Some of the cases that require colostomy may later have the bowel brought to the perineum and the colostomy closed. Our case, No. 123004, was so treated. A rectal tube was placed in the distal colostomy opening and helped identify the lower end of the bowel at the time of the perineal dissection. After closure of the colostomy, the child had good bowel control.

#### SUMMARY

1. Twenty cases of malformation of the anus and rectum have been reviewed.
2. Important points in their recognition, study, and treatment are discussed.

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# THE MANAGEMENT OF OSTEOMYELITIS SECONDARY TO WAR WOUNDS

K. ARMAND FISCHER, B.S., M.D., F.A.C.S., Louisville, Kentucky

THE occurrence of long existing suppurating wounds associated with compound fractures has been one of the most important problems encountered by the military orthopedic surgeon. The circumstances under which soldiers receive wounds, that is, with dirty clothing in place, fragments of land mines carrying infected soil into wounds, shell bursts which plow up the ground and then reach the limb, and the delay in getting surgical care, all go to make a great number of infected fractures during a war. In spite of the hazards of military wounds, however, it has been surprising to see the number of limbs which healed quickly when early medical care was given. The majority of the compound fractures treated by the temporary open wound method healed in the same period that a closed fracture would unite in civil life.

## TYPES OF CASES

The usual compound fracture patient who was received in a general hospital from overseas had a well fitting cast with the fracture in good position and alignment. If there was a foul odor to the cast, the plaster was changed soon after admission to the hospital because every man wanted a furlough or leave as soon as possible. Usually the wounds at that time were mere granulating areas which needed silver nitrate cauterization, a skin graft, or sometimes the patient had already undergone a secondary closure. In other cases bone was exposed in the wound and frequently loose sequestra could be lifted out. This type of patient showed no sign of sepsis and his general health was good. His blood count, hemoglobin, and hematocrit readings were normal. His state of nutrition was good, and he needed very little treatment other than cast immobilization until sufficient healing of the bone had occurred. Practically every one of these patients was started on some therapeutic exercise

to the injured limb even while in the cast, moving the neighboring joints or muscles underneath the cast. At times, in other cases, there was so much drainage from unhealthy soft tissue wounds that the surrounding skin was in bad condition from the presence of the secretions. These later suppurating wounds were treated in whirlpool baths for a period if the bones were in a condition to allow a minimum of immobilization. These warm water baths helped to clean up the wounds and skin very quickly.

Another group of patients had unhealed or healing fractures with suppurating wounds with a definite bone infection as shown by x-ray examination. In some sequestra, shell fragments, and débris were present; in others good drainage was lacking. The majority of these patients showed very little, if any, systemic changes due to the bone infection. Their nutritional state was excellent and their blood count, hemoglobin, and blood volume were normal. These patients usually needed surgical treatment and an attempt was made to eliminate the infected areas in from 3 to 4 months following injury. In some instances the removal of a sequestrum or foreign body resulted in permanent healing of the wound; in others dead bone was found attached to callus because surgery had been inadequate to insure continuous drainage of small or large spicules of bone and dead tissue.

Another group of patients who had had severely traumatized extremities with long existing suppurating wounds, showed marked evidence of the systemic effects of chronic sepsis. This type of patient was more difficult to treat, and it took a much longer time for healing to occur. These patients had very little immunity to their infection and were in an extensively depleted state.

The septic and depleted patient was in no condition to withstand surgical drainage, removal of foreign bodies and dead bone, or

of penicillin together with sulfadiazine were started 4 days before surgery and were continued after surgery for 4 to 5 days and little, if any, reaction followed.

After 4 to 7 days' preparation, a compound fracture with osteomyelitis was usually ready for some type of surgery. At operation a pneumatic tourniquet was used when possible, and it has proved to be a very valuable adjunct to this type of surgery of the arm, forearm, and below the upper one-third of the femur. The blood was expressed from the extremity with elastic bandages or by elevation previous to the application of the tourniquet. The advantages of a dry field for this type of surgery are that one could see the diseased areas of bone more clearly and furthermore the amount of blood lost was kept at a minimum.

At the time of surgery the draining sinuses were opened widely down to the infected fracture. All loose and dead fragments of bone, metallic fragments, and debris were removed. A generous saucerization of the bone was done. The scarred and avascular tissues were excised from the wound. Then the wound was flushed with normal saline to remove any small bone and soft tissue debris. Then moistened muslin or nylon strips which were close meshed were used to line the depths and sides of the wound, and mechanics' waste or gauze was packed on top of the muslin with gentle firm pressure. All patients were immobilized in plaster or traction. Postoperative oozing was controlled by elevation of the part, and if the pack had been placed correctly, there was usually a minimum of bleeding. In extensive saucerizations, the patient frequently needed a transfusion during or after surgery, depending on the amount of blood lost. From 200,000 to 500,000 units of penicillin were given in 2000 cubic centimeters of saline in the first 24 hours after operation. After that period the drug was given intramuscularly at 3 hour intervals in 25,000 unit doses during the day. Sulfadiazine was started after surgery as soon as the patient could tolerate it by mouth. As soon as possible, these patients were placed on the high protein, high caloric, and high vitamin diets.

Several days following surgery a blood count, hemoglobin, and other laboratory anal-

yses were made to determine the patient's reaction to the surgery. Transfusions were given as often as was necessary to make the red blood count and hemoglobin of these patients approach the normal in order to build up their resistance and immunity to infections.

Following saucerization surgery, the wounds were treated by one of several methods. The procedure that was used most extensively was the application of a split thickness skin graft. On the sixth or seventh day following the initial surgery, the cast was removed, and the wound packing was taken out. Cultures were made from the wounds for study. At this time, there were usually fine healthy granulations present with a clean appearance of all the tissues. If, however, the wound appeared dirty with some necrotic tissue showing, and definite areas of pus present, then further surgical and possible chemical treatment of the wound was necessary to make it receptive for a skin covering. Otherwise on the following day, the packing was removed, and a split thickness skin graft was taken with a Padgett hood dermatome and applied to the depths and sides of the wound. The grafts measured from .014 to .018 inch, the thinner grafts being used in the least favorable recipient sites. Before applying the skin, the saucerized defect was prepared by freshening the surface of the wound with a scalpel or gauze, removing any necrotic tissue, slough, or blood clot. Then the defect was irrigated thoroughly with saline and packed with warm moist gauze until the skin was applied. The skin was tailored to fit the defect without tension, and the graft was sutured to the wound edges with interrupted silk stitches. The grafts were perforated in several areas to allow the escape of excess secretions. A layer of boric acid ointment gauze was applied over the skin, and gauze packing or mechanics' waste was inserted in the defect on top of the skin. Dry dressings were placed on top of the packing, and an ace bandage was used to maintain an even firm pressure in the wound. Plaster splints were applied to the extremity, and the limb was elevated on returning to bed. Penicillin and sulfadiazine which were begun before the saucerization were continued after skin grafting for 5 to 7 days. At the end of a

week, the wound packing and boric ointment gauze were removed, and the graft was exposed to the air. A heat lamp was applied two or three times a day for 15 to 20 minutes if the graft was moist.

Another type of wound treatment following saucerizations that proved to be a very valuable procedure was the method of secondary closure. When the wound edges were not separated widely, and there had been only a minimum of soft tissue loss, these conditions seemed to be ideal for a delayed closure. If one expected to use this method following saucerization, the wound was packed similarly to that mentioned before the skin grafting procedure. Seven to 10 days later, the packing was removed, and the wound inspected. If it was clean, then a moist pack was inserted, and the patient was made ready for surgery on the following day. At surgery, the skin edges were excised, and the soft tissues were loosened up enough to approximate the skin and subcutaneous tissues. After a thorough cleansing of the wound with saline, the skin and subcutaneous tissues were closed with through-and-through stitches, avoiding if possible the use of buried sutures. If any dead space remained, a soft rubber drain was inserted for several days. In case the wound looked grossly infected and dirty, treatment with irrigations and penicillin packs was carried out for a time before closure was attempted.

Another method of delayed closure used successfully in superficial saucerizations was the shifting of a lateral flap of skin and subcutaneous tissue over the wound and the suturing of the edges. The bare wound left after the flap was moved was covered with a split thickness skin graft where needed.

Treatment of osteomyelitis secondary to war wounds by primary closure was carried out in a number of instances at the time of saucerization. Frequently when there were foreign bodies in infected bone, infections of the ilium and other pelvic bones, and cases of insidious drainage with sequestra present, primary closure proved to be an ideal treatment. At times a flap of skin and subcutaneous tissue was shifted over the saucerized area, as mentioned under secondary closure, and a

split thickness graft placed over the denuded area.

#### ANALYSIS OF RESULTS

An analysis of the results of wound treatment following saucerization surgery by skin grafting, secondary closure, and primary closure has been made. No case was considered successful unless the wound had been healed for at least 3 months. The results with the skin grafting type of treatment have been most satisfactory. A recent survey of 264 cases revealed a complete healing of 25 per cent of the wounds in 30 days. At the end of 60 days, another 50 per cent of the cases had healed, leaving 25 per cent unhealed. Of this latter group only 6 per cent were complete failures. The remaining patients needed a partial resaucerization and skin graft. The failures of this method have been judged to be due to a poor blood supply to the tissues under the graft, a lack of maintenance of firm even pressure by the dressing after skin graft surgery, and lastly due to infected tissues under the graft and incomplete saucerization surgery. The skin graft method has been very popular with the patients in military hospitals because it created a closed wound from a dirty infected one in a short period, eliminating the dressings, odors, and inconveniences of some other methods. Since the soft tissue wounds healed quickly with this method, the bones likewise healed rapidly when they received a skin covering. However this treatment did not eliminate altogether the need for further surgery in all the cases. Many deep and wide wounds having a thin skin covering needed good skin flaps with fatty subcutaneous tissues when further bone surgery was planned to keep the wounds from breaking down with usage, and in others for cosmetic reasons. These patients were usually given a trial of 3 months hard usage on the extremities if the bones had healed. At the end of that period if the skin wounds had not broken down, then the patient did not need to undergo further surgery unless he wanted it for cosmetic reasons.

The results of delayed closure were very encouraging, the wounds showing some drainage in 9 instances out of 42 cases which were



followed. A number of these wounds closed spontaneously after a few weeks' drainage. The secondary closures in which a drain was inserted at the time of surgery because of a dead space, usually closed spontaneously in the majority of instances within 7 to 10 days following removal of the drain. The failures in this group of cases were attributed to incomplete surgery and the leaving of a dead space where tissue fluids collected.

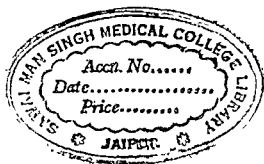
Primary closure was used in 46 patients, and wound drainage following surgery occurred in 10 instances. This low percentage of reinfection could probably be accounted for by the proper selection of cases for the use of an immediate closure.

#### SUMMARY AND CONCLUSIONS

The management of osteomyelitis secondary to war wounds has not been a problem of curative surgery alone. At times intensive constitutional treatment was necessary to alleviate the attendant anemia, hypoproteinemia, and disturbed fluid balance in the septic and depleted patient.

Frequently the patient was in a low mental state.

Five methods of wound treatment following sequestrectomy and saucerization were used. This study has revealed that delayed closure, primary closure, and skin grafting were very useful procedures in creating an early closed wound from an open infected one.



# THE SURGICAL TREATMENT OF GANGRENE IN TRENCH FOOT

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**T**HOUGH gangrene in trench foot has similarities to gangrene in other vascular disorders, it presents certain problems which are peculiar to this condition. Distinguishing features are the high incidence of infection, the occurrence of either superficial or deep gangrene of limited or considerable extent, the lack of pain due to the gangrene itself or the resulting ulceration, the common association of intense vasospasm, and the absence of any extensive arterial obliteration in the foot proximal to the area of gangrene.

Trench foot gangrene differs from the gangrene of thromboangiitis obliterans, arteriosclerosis, and other obliterative diseases chiefly because of the general absence in trench foot of the reduction in the circulation of the foot from obliterative arterial changes so regularly present in these diseases. Conversely, whereas relatively normal circulation rarely prevails in the obliterative disorders upon elimination of vasoconstrictor impulses, relatively normal circulation does generally prevail in the case of trench foot. Trench foot gangrene further differs from the disorders named in the general lack of any severe rest pain even when open ulcers are present. Initially there may be very distressing rest pain in patients who have trench foot, whether gangrene is present or not, but after an interval of some weeks or months the majority of patients have little or no pain at rest. Though infection sometimes complicates gangrene in the obliterative diseases, it is much more commonly present in trench foot with deep gangrene. Skin defects can rarely be covered by grafts in the former but can often be repaired in this manner in trench foot.

In Raynaud's disease and like disorders the ulcerations and gangrene are generally superficial and limited in extent. In trench foot the

gangrene may be superficial or deep, limited or extensive. The gangrene of trench foot is closely allied to that which follows frostbite and immersion foot. All of these disorders are alike in that obliterative arterial changes are largely limited to the areas of gangrene and perhaps to areas immediately proximal to these. Patients with frostbite and disorders resembling Raynaud's disease tend to have few symptoms associated with gangrene other than cold sensitivity and hyperhidrosis which are very common in the former and the rule in the latter. In trench foot and in immersion foot, on the other hand, there are generally associated symptoms consequent to damage of nerves and muscles in the foot proximal to the area of gangrene. Areas of hypesthesia or hyperesthesia, atrophy of muscle, and contractures are relatively common in trench foot, and almost all patients have pain on weight bearing. These symptoms are prevalent in trench foot without gangrene and are not due to postural difficulties resulting from the ischemic loss of tissue. Hyperhidrosis, coldness, and cyanosis are commonly present.

It is the purpose of this communication to discuss certain problems which have arisen in the care of patients with gangrene from trench foot and to describe the manner in which they have been handled.

## THE PROBLEM OF INFECTION

Infection was very commonly associated with the gangrene of trench foot. Infection was often minimal in instances of superficial gangrene but presented a serious problem in cases with deep gangrene, almost all of which had extensive infection. The circumstances in which trench foot is incurred all favor the introduction of infection. In the first place, the hygiene of the feet is necessarily often neglected under conditions of combat. At the time of exposure the patient has generally been unable to change his wet shoes and socks

From the Vascular Center, Mayo General Hospital, Galesburg, Illinois.

for a period of days or weeks. In addition to the tendency for skin maceration and bleb formation which appears to be the direct result of ischemia resulting from the exposure, the continual wetness of the feet and the edema further favor maceration of the skin. The blebs, skin desquamation, and loss of nails, which occur so commonly, serve as portals of entry for pathogenic organisms. Not infrequently the blebs on the digits are undergoing gangrenous changes.

When the patients are first seen as they are returned to the Zone of the Interior the gangrenous parts often are partially separated at the line of demarcation and this area is generally bathed in foul smelling pus. Sometimes there is evidence of extensive infection throughout the gangrenous portions. Not infrequently where the gangrene appears to be "dry," one finds on removal of this tissue through the line of demarcation that the gangrenous part is simply covering a pool of pus. The infection is invariably a mixed one and very commonly penicillin and sulfonamide-resistant *Bacillus proteus* and *Bacillus pyocyaneus* are present in addition to susceptible organisms.

Most of the patients were treated either with sulfadiazine or with penicillin. All of them were treated with sterile warm saline compresses. The gangrenous parts were excised or amputated through the line of demarcation. After this procedure was carried out there was a marked improvement in the infection. In no instance was there spread of infection to adjacent soft tissues. Osteomyelitis in the proximal stump, however, was often present and not infrequently required sequestrectomy, revision of stumps or other measures. The presence of infection handicapped treatment by precluding in most instances the primary closure of amputation stumps. Although the infection cleared grossly under treatment, it persisted in sufficient degree to offer some handicap to the success of split thickness and other skin grafts.

Of the measures instituted in order to control infection, it is felt that removal of the gangrenous parts and the use of warm sterile saline compresses were most efficacious. Not infrequently it was necessary to protect the

intact skin with some ointment such as zinc oxide in order to prevent maceration during the period compresses were in use. This tendency to skin maceration seemed to have been greater than in normal limbs. It may have been due in part to the fact that large areas of skin were often only recently epithelized following extensive desquamation. It may have been due in part to the excessive hyperhidrosis which many patients had. With regard to sulfadiazine or penicillin it is felt that these drugs may have had some effect in preventing spreading of infection. If they had any beneficial effect upon the local infection itself this was not apparent. Use of aqueous mercurochrome locally proved more successful in clearing *Bacillus pyocyaneus* infection than dilute acetic acid. Unfortunately streptomycin was not available. From my small later experience with this drug in other infections in gangrenous stumps, it is believed that it might have been very useful.

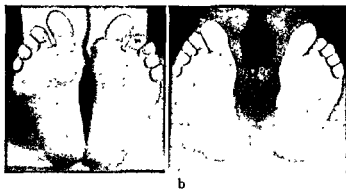
A number of instances of apparently "dry" superficial gangrene have been seen in which there was present under the crust an active infection which led to osteomyelitis. In such cases amputation was often necessary. Because of this occurrence, it is my opinion that when areas of superficial gangrene fail to separate promptly they should be compressed in an effort to hasten separation of the gangrenous tissue, and epithelization.

#### THE PROBLEM OF VASOCONSTRICTION

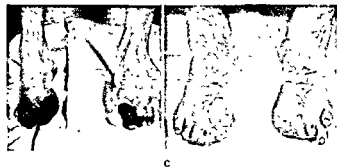
Elsewhere (2) the problem of vasoconstriction in trench foot with gangrene has been discussed and the utility of lumbar sympathetic ganglionectomy in correcting this disorder has been described. It is sufficient to say that the majority of patients with deep gangrene presented evidence of rather marked vasoconstriction. The feet were frequently cold, cyanotic, and sweated profusely. In some cases the occurrence of vasoconstriction was masked by the infection and the local heat associated with the inflammatory reaction. In such cases cooling of the feet was observed as the infection cleared. In a few patients the feet were not only warm but had almost complete absence of sweating. Such cases were relatively few.



a



b



c

Fig. 1. Photographs of feet of patients with gangrene which healed following sympathectomy and excision of the gangrenous parts without further surgery. In the 3 cases illustrated the gangrene was deep and extended down to the bony structures. Patient whose feet are shown in a, upper left, also had an area of gangrene on the sole of the foot which healed after sympathectomy. Patients in b, upper right, had unilateral and patient in c, at left, had bilateral sympathectomy.

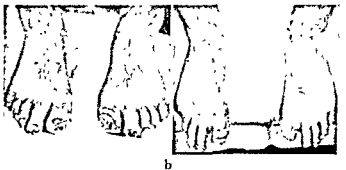
Although eventual healing can generally be obtained without sympathectomy, it is felt that this procedure has been most useful in bringing about prompt healing and in limiting the amount of tissue loss (Figs. 1 to 5). Thirty-eight lumbar sympathectomies were performed in 30 patients with deep gangrene. Satisfactory and fairly prompt healing occurred in all. Where small split grafts were attempted there was often difficulty in securing takes, but tube transfer grafts were as successfully transferred as to normal limbs.

It was often striking how rapidly epithelization took place following sympathectomy. The contrast of this rapid epithelization to the former slow healing was especially evident in those cases in which sympathectomy had been performed in the presence of marked vasospasm. After operation the feet were warm, of good color, dry. The dryness was readily controlled with a daily application of lanolin.

In 17 patients with trench foot following unilateral sympathectomy, skin temperatures of the toes or stumps averaged 25.8 degrees C,



a



b

Fig. 2. Photographs of feet with gangrene, showing healing after sympathectomy and revision of stumps. A unilateral sympathectomy was done in patient in a, bilateral in patient in b. The gangrenous part was excised in patient a at the time of sympathectomy. Three and one-half weeks later a split graft was applied to the ulcer

but this failed to take. Three weeks later the distal phalanx was amputated, the stump revised, and sutured. Patient, whose feet are shown in b, had initially excision of the gangrenous parts and a bilateral sympathectomy. At left, b, is illustrated the condition following this procedure. This patient demonstrates the difficulty resulting from infection. A split graft applied to the left great toe failed to heal. Both great toes required revision because of osteomyelitis and the right 5th toe was amputated because of osteomyelitis.

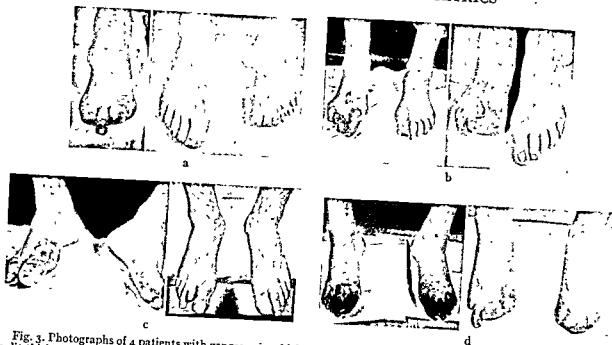


Fig. 3. Photographs of 4 patients with gangrene in which split thickness grafts were of considerable aid in obtaining a good healing with minimal loss of tissue. Unilateral sympathectomy was done in patients shown in a, b, c, and bilateral in patient in d. Split thickness grafts were uti-

lized in covering the stumps of the 1st, 3rd, and 4th toes in a, the ulcer over the end of the metatarsals in b, the defect along the dorsomesial aspect of the toe in c, and the ulcers over the stumps of both 1st toes in d. A good functional result was obtained in all cases.

in the untreated limb and 33.2 degrees C, in the sympathectomized limb. Oscillometry at the ankle averaged 2.6 on the untreated side and 4.6 on the side operated upon. In general,

the dorsal pedal and posterior tibial pulses were present and full, and there was no evidence to suggest any extensive obliterative change in the arteries of the foot. It is very



Fig. 4. Photographs of feet of 2 patients in whom tube transfer grafts were utilized. b, left, represents the condition on admission, a, left, and b, right, the condition following amputation and a, right, and c, left and right, the final result. Both patients walked surprisingly well and with little discomfort. Sympathectomy was done in both patients.

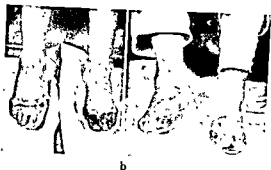
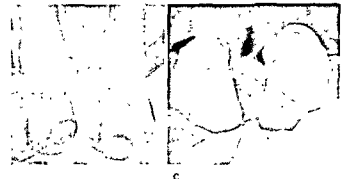


Fig. 5. Photographs of feet in which tube transfer grafts were utilized. *a*, left, represents the condition on admission and *a*, right, the final result. In this case both 4th and 5th toes were preserved but were subsequently amputated because of stiffness and discomfort. *b*, left and right, shows the condition following amputation in another case. The heads of the metatarsals are exposed. *c*, left and right, shows the final result after transfer of full thickness skin to both feet by means of a tube graft. Both patients had bilateral lumbar sympathectomy. A good functional result was obtained in both cases.



probably true that there may be thrombosis of the digital artery or small branches in the stumps adjacent to the line of demarcation.

#### THE PROBLEM OF AMPUTATION

Because of the prevalence of marked infection, closed amputations were rarely possible. Generally the gangrenous plaques and the

gangrenous digits were amputated through the line of demarcation shortly after admission. If sympathectomy was performed, amputation was carried out at this time. Protruding stumps of bone were often left because the infection made it inadvisable to carry out a complete revision. Subsequently the stumps were revised, rongeur away the protruding



Fig. 6. Photograph of patients who had extensive gangrene. In patient *a*, both feet were entirely gangrenous, and leg amputation was necessary. Patient in *b* had undergone prior to admission an amputation which was partially tarsal-metatarsal and partially through the proximal metatarsal area. The stump was painful and entirely unsatisfactory. He was transferred to an amputation center for a Syme's revision. *c*, Shows the end-result in a patient who had lost all toes and in whom healing occurred after sympathectomy. Because of the thin adherent skin over the stump, this was revised by sacrificing most of the head of the 1st and 2nd metatarsals. Though the stump was satisfactory it was felt that a more useful stump would have been obtained had a tube transfer graft been used instead of reamputation.



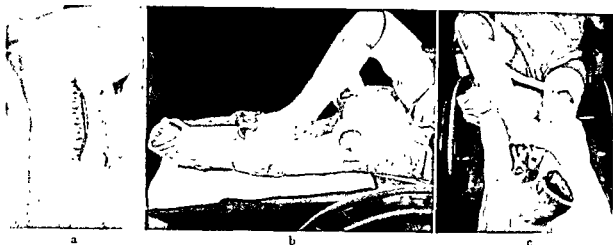


Fig 7 Photographs showing the tube used in transferring skin, a, and the method of mobilization, b, and c.

phalanges. In many instances disarticulation was performed. No difficulty was encountered from disarticulation, and osteomyelitis in the stump was less common following this procedure than following amputation through phalanges. Every effort was made to avoid traumatizing the stump at operation and all the tissue possible was conserved. I feel that this policy of conservatism gave good results.

The extent of gangrene varied. In some patients a single toe was gangrenous and in others gangrene involved all the toes. In some the gangrene was limited to the distal or the distal and mid phalanges. In others the toes were completely gangrenous. In 13 extremities the gangrene was sufficiently extensive so that following amputation the heads of metatarsals were left exposed and in 7 it was necessary to remove portions of the metatarsals. Frequently in such cases it was necessary to cover the defect with full thickness skin by transfer graft. Where only a portion of the heads of metatarsals had to be sacrificed, useful feet were obtained. Only in 2 cases was foot or leg amputation necessary. One was a patient who had gangrene of both feet (Fig. 6a). He was transferred to an amputation center for a leg amputation. Another patient had undergone an amputation, partially tarsal-metatarsal, partially through the proximal portion of the metatarsals (Fig. 6b). His stump was painful, unstable, and entirely unsatisfactory. He was transferred to an amputation center for a Symes revision.

#### THE PROBLEM OF SKIN GRAFTS AND PLASTIC REVISION

In most patients skin grafting was unnecessary (Fig. 1). Where amputation was carried out through the phalanges, epithelization generally occurred promptly. In most of them the new skin was good enough to withstand the trauma of walking without difficulty. In a few instances a thin skin was adherent to bone and in these cases revision with primary closure could be performed. When a large defect occurred, particularly in instances where the entire toe or toes had been lost, it was desirable to cover the defect with a split thickness graft to serve as a temporary dressing even should full thickness skin subsequently have to be transferred. In general, split thickness grafts had a high instance of failures. It was apparent that this difficulty resulted from infection rather than from poor circulation in the stump. Occasional split thickness grafts were entirely satisfactory in covering defects (Fig. 3).

In 5 cases it was necessary to utilize tube grafts (Figs. 4, 5, and 7). In all of these cases the metatarsal heads were exposed. Fortunately, the skin of the sole was generally intact so that the graft would largely be on a non-weight bearing surface. When the first patient was operated upon it was my plan to elevate a double pedicle graft or tube from the opposite leg, to place beneath it a split thickness graft, and subsequently to transfer it to the defect of the foot. I was surprised to find

at operation that sufficient atrophy had taken place to permit primary closure of the skin beneath the pedicle. Primary closure was done, and the pedicle was converted into a tube. Three weeks later the tube was divided at its lower end and sutured to the defect of the foot, the limbs being held in place with plaster of Paris. In the other 4 cases in which transfer grafts were necessary it was found possible to utilize the same procedure.

The technique involved was as follows: Two parallel incisions were made on the posteromedial aspect of the contralateral leg. The width and length of the pedicle were determined by the size of the ulcer to be covered. The anterior incision was placed just posterior to the saphenous vein, and care was taken to avoid injury to the saphenous nerve. The skin between the 2 incisions was elevated with the underlying subcutaneous fat. The pedicle was gently retracted and the margins of the skin were sufficiently reflected both anteriorly and posteriorly to permit closure without tension. The pedicle was then converted into a tube by approximation of the skin edges with interrupted fine cotton sutures (Fig. 7). Between the second and third week after operation circulation in the tube was tested by application of a rubber tourniquet about the distal end of the tube. In all cases good circulation was maintained in the tube during a period of constriction with a rubber tourniquet. At the second operation the tube was divided at its lower end and the defect of the leg was closed by suture. The tube was then opened and sutured in place to the freshly mobilized skin edges about the area of the ulcer. The limbs were held in proper approximation so that the tube was not constricted and position was maintained with a plaster cast to both lower extremities (Fig. 7). In general the patients found this position comfortable. Three weeks later the cast was removed, the proximal end of the tube was divided and the free end of the graft was sutured in place.

In no instance was such a graft lost. In a single instance about 10 per cent of the distal end of the graft was lost but the small resulting ulcer readily healed and presented no difficulty. In one instance a small draining

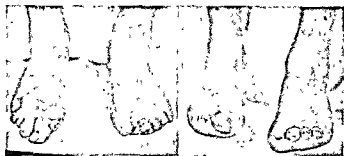


Fig. 8. Photograph illustrating contractures of toes in trench foot, a, left. The patient had comfortable feet following amputation and revision of stumps, b.

sinus persisted in a portion of the suture line and considerably prolonged the patient's hospital stay. After efforts to obtain healing by saline compresses, curetting, and excision of the margins with a closure, a small sequestrum from the head of the metatarsal was finally discovered and healing occurred promptly after its removal.

When gangrene is limited to a portion of a toe and revision of the stump is necessary because of thin adherent skin or because of osteomyelitis, no harm results from the sacrificing of a small amount of tissue. When the metatarsal heads form the stump, however, it is my conviction that they should not be removed in order to permit bringing good skin over the stump. It is far better to cover such defects with full thickness transfer grafts. In Figure 6c is shown one patient in whom such a revision was carried out. Although the foot functions fairly well I have no doubt, in retrospect, that a much more comfortable and useful foot would have been obtained if a graft had been used and the metatarsal heads left undisturbed.

Stiffness and contractures of toes were not uncommonly seen in patients with trench foot without gangrene, and similar difficulties were sometimes encountered in patients who had sustained loss of tissue through gangrene. The stiffness of the toes could generally be satisfactorily cleared with physiotherapy and exercise. The commonest deformity resulted from an extensor contracture. Flexion contractures were fewer. Contracture was more common in cases of stumps of toes than where the entire toe was present. This condition was sometimes amenable to physiotherapy and the use of metatarsal bars. In a few instances in



which the contracture was severe and disabling, amputation was carried out. In such cases the deformity was generally so great that amputation was felt preferable to the conservative surgical methods (Fig. 8).

#### PROSTHESES

When all of the toes were removed a sponge rubber or cotton pad was placed in the distal end of the shoe to prevent the foot from sliding forward. In an occasional case where the great toe was present and the second or second and third toe had been amputated, a chamois covered sponge rubber pad which could be inserted between the toes and kept in place with a sock proved useful in preventing a hallux valgus deformity. In some patients with relaxation of the foot and discomfort on walking, resilient arch supports were helpful. In general the patients had little difficulty in standing or walking other than for slight or moderate discomfort in the metatarsal area. This pain on weight bearing was not peculiar to the patients who had undergone amputations, but occurred just as frequently in patients with trench foot who had had no gangrene at all. It was often helped by placing a second heel in front of the heel of the shoe or by the use of a metatarsal bar (1).

#### DISCUSSION AND CONCLUSIONS

Superficial gangrene in trench foot does not present a serious problem. Very often satisfactory healing takes place beneath the crust or following its separation. Occasionally superficial gangrene results in more serious difficulty because of the presence of underlying infection which may give rise to osteomyelitis. In such instances partial or complete amputation of toes may be necessary. Deep gangrene is a more serious difficulty. In the great majority of patients this gangrene is limited to portions of the toes. In a lesser number, entire toes are involved, and in some patients, gangrene is so extensive that the heads of metatarsals are left exposed following amputation.

Infection of a mixed character is present in the great majority of patients with deep gangrene. Such infection has been controlled satisfactorily with sulfadiazine or penicillin

and with the local application of warm saline compresses following removal of gangrenous parts. Spreading of infection into adjacent soft parts did not occur. Occasionally osteomyelitis was present in the stumps. The infection tended to retard healing somewhat and to interfere with the success of split thickness grafts. It is felt that streptomycin would be of help in regard to infection, as organisms resistant to sulfonamides and penicillin are commonly present.

Vasoconstriction, sometimes intense, was present in the majority of patients. It is felt that lumbar sympathetic ganglionectomy is a useful adjunct in the treatment of deep gangrene of trench foot and that it results in more speedy healing and in conservation of tissue. In case skin defects have resulted from the loss of parts, epithelization has often occurred rapidly and in many instances the resulting new skin has been sufficiently good to withstand the trauma of walking. When the defects are large, occasionally satisfactory outcome is obtained by permitting epithelization from the margins.

In general it is advisable to cover such areas with a split thickness or full thickness graft. If the ends of metatarsals are exposed, a full thickness covering of skin is generally necessary. This covering is best applied by means of a transfer graft from the opposite leg. The most suitable means of carrying out this skin graft has been found to be a tube transfer graft. Because of the atrophy present it was possible in the first stage operation to elevate the tube and to close the skin margins beneath it without tension. Should this step be impossible a double pedicle flap can be elevated and sutured back in position or converted into a tube after there is placed beneath it a split thickness graft. The stump is satisfactory for standing or walking if all the toes are removed or if parts of the metatarsal heads must be removed. If amputation must be carried out more proximally through the metatarsals, the stump is generally unsatisfactory.

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# A STUDY OF THE ABSORPTION CHARACTERISTICS OF SURGICAL CATGUT

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SINCE the introduction of catgut as a surgical suture material by Lister the problem of its absorption characteristics has been of vital interest to the medical profession. Numerous papers have been published and considerable time and energy have been expended in an effort to get a better understanding of the absorption process and of the best possible methods of controlling it so as to make available to the surgeons a product which is adequate to meet their needs. Some of this work has been carried out by investigators who have been handicapped by the need of obtaining their material through purchase on the open market and, consequently, have had no control over a number of factors which could have very definite bearings on their results. They have attempted to minimize this handicap by the multiplicity of their experiments and have succeeded in contributing much to the present knowledge concerning sutures.

We have been fortunate to be in a position in which we could obtain the raw material and process it ourselves so that all variables incident to the manufacturing process were controlled (chromicization, sterilization, et cetera). For this reason, and because we have occasion to introduce several new concepts, we believe that the results of our experiments will shed some new light upon the subject.

## RELATIONSHIP OF TRYPTIC DIGESTION OF CHROMICIZED COLLAGEN TO SHRINKAGE TEMPERATURE AND THE CONTENT OF CHROMIUM

*In vitro* digestion of collagen. In order to correlate absorption of collagen implanted in the animal with proteolytic digestion, *in vitro* trypsin as well as pepsin have been used in the past. Kraissl and Melency have used trypsin while Jenkins and Hrdina (5) used pepsin; however, no explanation has been presented for

the choice of either one of the enzymes employed.

There is no doubt that the peptic digestion is influenced to some extent by the same factors as *in vivo* absorption and that valuable information can be and has been obtained in the past by this method. Jenkins and Hrdina arrived at a nearly linear relationship between "the duration of tensile strength in tissue" and "digestion time in acid pepsin." Although the applicability of pepsin to these problems has been clearly demonstrated by Jenkins and Hrdina, we feel that an enzyme more closely resembling the proteolytic enzymes of the tissue (cathepsin, et cetera) would be a better choice. In this connection, it can be pointed out that the  $pH$  optimum for pepsin is between 1 and 2, while the optimum of the proteolytic enzymes of the tissue is around 7. Furthermore, pepsin digests undenatured as well as denatured collagen quite readily but undenatured collagen is very slowly absorbed in animals. It has also been observed that digestion with pepsin seems to carry the collagen through a gelatinous state before breaking it down to polypeptides, which is not the case in animal absorption.

In trypsin we have a proteolytic enzyme which meets our requirements better. It has its  $pH$  optimum in the same region as cathepsin, undenatured collagen is not (or at least is very slowly) hydrolyzed, and no gelatinous intermediate product is found. Due to difficulties of preparation we have avoided the use of cathepsin itself; however, we feel that trypsin for our purpose is an adequate substitute.

The trypsin preparation used was a crude preparation from Central Scientific Company (Chicago). No attempt at purification was made, as all the digestion results were relative in nature.

In some of our earlier digestion experiments we have used the technique of determining the

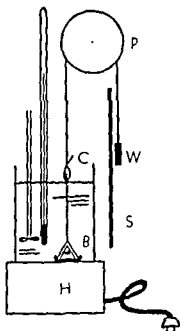


Fig. 1. Shrinkage temperature apparatus. *B*, base; *C*, battery clamp; *H*, heating element; *P*, pulley; *S*, screen; *W*, weight.

time it takes to break a strand immersed in the enzyme solution under mild tension. This technique, which was first introduced by Kraissl and Meleney, gives good, statistical results but is somewhat unreliable in a single experiment. This method was, therefore, replaced by determinations of the nitrogen content of the hydrolysates expressed as percentages of the initial collagen nitrogen present.

**The shrinkage temperature.** A collagen suture behaves in a remarkable manner when it is immersed in water and the temperature of the water gradually raised. At a rather definite temperature it contracts in the direction of the fiber axis and becomes elastic like rubber. This transformation temperature, or shrinkage temperature, can be measured nearly as accurately as a melting point of an organic compound. That a change in the configuration of the molecule has taken place can be clearly observed by x-ray diffraction and also deduced from the fact that collagen, which prior to the heating was practically indigestible by trypsin, now becomes readily digestible.

The shrinkage of collagen is without doubt closely related to the denaturation of a soluble

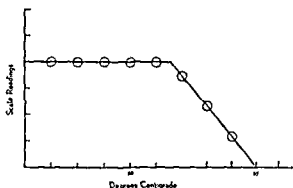


Fig. 2. Typical measurement of shrinkage temperature of surgical gut.

protein and can, therefore, be characterized as a denaturation since the mechanism of both processes is fundamentally the same. Thus, the change in viscosity of a protein solution when denatured is explained as a change in shape of the protein molecule.

The measurement of the shrinkage temperature is conveniently done in the following way (Fig. 1). The catgut attached to a base *B* is suspended in a vertical position in a metal container and submerged in water. The upper part of the gut is attached by means of a battery clamp *C* to a cord which runs over a nearly frictionless pulley *P*, having a weight *W* attached to the free end. The weight is 1 gram heavier than the battery clamp and serves to keep the catgut straight when in a swollen condition. The position of the weight is read against a screen *S* which is covered with a piece of graph paper. The bath is slowly heated and a reading is taken for every degree rise in temperature. Figure 2 shows a typical measurement. The intersection point between the two lines gives the shrinkage temperature which, in this example, would be 51.8 degrees C.

The process of chromicizing catgut sutures is essentially a tanning procedure. In the tanning industry measurements of shrinkage temperatures are more and more replacing the old boiling test as a control of the degree of tanning. Apparatus similar to the one presented here are available commercially for this purpose. For physicians it is interesting that this shrinkage was used as early as 1873 by Engelmann as a physiological demonstration of the phenomenon of muscle movement.

The shrinkage temperature is, as could be expected, a function of  $pH$  of the solution; thus, undenatured catgut has a shrinkage temperature of about 60 degrees C. in neutral solutions and around 45 degrees C. in solutions of  $pH$  3.0. The salt concentration also has an influence and, characteristically, the calcium ion lowers the shrinkage temperature considerably more than any other ion. The condition of the catgut itself (for instance, content of chromium or degree of denaturation) profoundly influences the shrinkage temperature. In our studies, we have not been interested in a study of the influence of  $pH$  or different salts on the shrinkage temperature but rather in the use of the shrinkage temperature as a means of characterization of the catgut itself. In all the measurements presented we have, therefore, kept the  $pH$  constant at 6.8 by using Sørensen's phosphate buffer solutions. For further information on this subject, which without doubt is of far-reaching physiological interest, the reader should consult the recently published book of McLaughlin and Theis, in which the chemical significance of the shrinkage phenomenon is discussed in detail.

Most of our digestion experiments have been made in connection with animal experiments and will be described in the following section; however, two experiments, which demonstrate the importance of the shrinkage temperature as a characterization of the catgut suture, will be reported here.

The tryptic digestibility of collagen is, as shown convincingly by W. Grassman, highly influenced by a prior heat treatment. As previously stated, collagen which has not been denatured is practically indigestible by trypsin; however, strands partly or completely heat denatured are digestible and, the more intense the preceding heat treatment, the higher the digestibility.

Heat treatment of collagen in the presence of moisture produces a higher degree of denaturation than a similar treatment under anhydrous conditions. Consequently, catgut manufacturers carry out their sterilization process in the absence of moisture.

Chromicized catgut sutures of three different chromium contents were divided into two

groups. The two groups were given different heat treatment (under conditions resembling the sterilization process) resulting in strands of different degrees of denaturation and, hence, different shrinkage temperatures. In another experiment, strands of different chromium contents were given the same heat treatment. In both experiments the shrinkage temperature and the relative tryptic digestibility were determined. The enzyme solution used was a 0.5 per cent solution of trypsin in phosphate buffer at  $pH$  6.8; 10 cubic centimeters of the solution was used to 0.4 gram of collagen. The temperature was 36 degrees C. and the digestion time, 48 hours. The results of both experiments are compiled in Table I, and the figures are arranged according to decreasing shrinkage temperatures.

When the figures are arranged in this manner, it is seen that the tryptic digestibility increases when the shrinkage temperature decreases in both experiments. When the heat treatment has been varied (the first experiment), the chromium content does not follow the shrinkage temperature and digestibility. However, in the second experiment where all of the strands have been heat treated in the same way the chromium content follows both the shrinkage temperature and the digestibility in an orderly fashion.

*It can thus be stated that surgical catgut is characterized not only by the chemical treatment it has undergone (chromicization or use of other tanning agents) but also by the degree of denaturation caused by the sterilization process and recorded by the shrinkage temperature.*

As will be demonstrated later, we have found a parallel relationship in our animal experiments.

#### THE PROPERTIES OF COLLAGEN SUTURES AFTER PERIODS OF IMPLANTATION IN ANIMALS

Jenkins and Hrdina (4) have found a satisfactory correlation between the absorption characteristics of surgical catgut in animals and in the human. While they worked mainly with dogs, it has been our experience that rabbits may be used to equal or better advantage in this type of work. Consequently, we have used rabbits in most of our *in vivo* experimental investigations.

TABLE I.—EFFECT OF HEAT DENATURATION ON TRYPTIC DIGESTION OF CHROMICIZED CATGUT.

Different heat treatment			Same heat treatment		
Shrinkage temperature	Tryptic digest per cent into solution	Chromic oxide per cent	Shrinkage temperature	Tryptic digest per cent into solution	Chromic oxide per cent
67.2	0.4	1.83	61.5	71	1.39
61.7	18.2	1.15	59.5	33	1.18
59.2	28.0	1.83	58.0	50	0.82
57.0	45.4	0.56	55.1	64	0.59
55.8	45.2	1.15	54.2	72	0.48
53.8	90.0	0.56	53.1	95	0.23

Sutures were imbedded in the dorsal muscles of the rabbits while they were under nembutal anesthesia. All implantations were carried out under aseptic conditions. The sutures were passed through the skin and into the muscles of the pelvic region by means of mattress needles about  $7\frac{1}{2}$  inches long drawn through the muscles of the back parallel to the dorsal surface of the animal and brought out through the skin in the scapular region. They were tied at each end to wound clips attached to the skin, care being taken to allow a slight amount of slack at each end so as to prevent too much tension being applied to the suture as the animal changed position. The area was then covered with a sterile gauze pad which was held in place by sterile bandages. Finally, the bandages were covered with adhesive tape. This technique is similar to that previously described by Howes.

The sutures were removed after predetermined intervals by loosening the wound clips and freeing the sutures after which they could be pulled out of the muscle without difficulty. The tensile strength was measured on a Scott tensile strength machine. While some investigators have dried the sutures before measuring the tensile strength, we felt that they should be tested in as nearly as possible the same condition as obtain in the tissue. For this reason all sutures were placed between damp towels and the tensile strength measured before any loss of fluid had occurred. Controls were kept between damp towels for  $1\frac{1}{2}$  hours before testing since it was found

TABLE II.—DIAMETER OF VARIOUS SIZES OF CATGUT USED

Type	Minimum diameter inches	Maximum diameter inches
L	.004	.006
M	.006	.008
N	.008	.010
O	.010	.013
P	.013	.016
Q	.016	.019
R	.019	.022
S	.022	.025

that such treatment gave results similar to those obtained from sutures which had been in the tissues about 45 minutes. This level was chosen as the control because it was found that catgut sutures decrease in tensile strength as they imbibe fluids from the tissues. The tensile strength level becomes fairly constant after 45 minutes in the tissues, and imbibition of fluids alone does not further reduce the strength. Approximately two thousand sutures were tested in this manner. This method of testing enabled us to determine the functional life of the sutures which we believe to be as important from the surgeon's point of view as the complete absorption time.

#### EFFECT OF IMPLANTATION IN ANIMALS ON THE TENSILE STRENGTH OF CATGUT SUTURES

In the first phase of this study type Q sutures with a chrome content of 0.6 per cent (Table II) were used. These were implanted in the dorsal muscles of rabbits in the manner described, 6 sutures being placed in each animal. The sutures were removed and the tensile strength measured after periods of 3, 5, 7, 9, 11, and 15 days. Two tensile strength measurements were made on each suture, and the average of 12 measurements made on 6 sutures from the same animal was taken as the final value. The average tensile strength was then plotted against the number of days in the rabbit. The sutures used for any particular series of experiments were all chromicized<sup>1</sup>, tubed, and sterilized at the same time so as to eliminate variations in these pro-

<sup>1</sup>All sutures were chromicized by a method which gave uniform chromicization throughout the suture.

TABLE III.—IN VIVO ABSORPTION PATTERN OF CHROMICIZED CATGUT

Days in animal	Chromic oxide per cent	Shrinkage temperature Centigrade	Wet tensile strength (in pounds)	Relative tryptic digestibility (percent into solution)
Control	1.48	63.2	15.5	6.6
3	1.29	57.8	10.3	30.1
7	1.18	56.3	8.0	44.2
11	1.06	54.8	5.5	77.5
15	0.00	54.2	4.0	71.4

cedures which might affect the rate of absorption. The chrome content of each batch of sutures was determined as well as the shrinkage temperature as a further check on their uniformity.

It was found that the tensile strength decreased in a fairly linear fashion for about 7 days at which time they retained approximately 30 per cent of their original wet tensile strength. From the seventh to the thirteenth day there seemed to be little further decrease in tensile strength (about 10%). From the thirteenth to the fifteenth day there was a rapid decrease so that after 15 days the sutures had little or no tensile strength remaining (Fig. 3).

Plain catgut studied in a similar manner decreased much more rapidly in tensile strength. After 3 days, only 33 per cent of the original tensile strength remained, and all but about 10 per cent of the strength had been lost after 5 days (Fig. 3).

These experiments were then repeated with surgical gut of various sizes (Type L to Type S) and chrome contents. The residual tensile strength curve had the same general shape in all cases and, what seemed more significant, the rate at which the tensile strength decreased was approximately the same regardless of the size of the suture. The exception to this seemed to be the very large sizes, particularly Type S, in which the initial rate of decrease in strength was slightly higher. This was attributed to the increased foreign body reaction produced by these sutures.

By chrome tanning alone it is difficult to make sutures which have a functional life greater than 15 days. In the case of Type Q sutures, it was possible, by increasing the

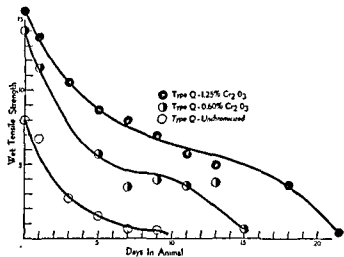


Fig. 3. The effect of implantation in animal tissue upon the wet tensile strength of surgical gut.

chrome content to 1.25 per cent, to extend the life of the suture approximately 6 days (Fig. 3). This holds also for smaller sizes on a percentage basis, but the actual strength of the extreme small sizes is so low that there is no improvement of practical significance. In the case of larger sizes an increased chrome content does not improve the suture appreciably due to the increased foreign body reaction.

To extend the absorption time of a suture appreciably beyond 15 to 18 days other procedures in addition to chromicization must be employed. This was found to be true regardless of the method of chromicization.

It has been assumed by some investigators that the decline in tensile strength of catgut in the tissues is a relatively constant factor. While the results of dry tensile strength measurements may lead to this conclusion, it is evident from the experiments just described that the wet tensile strength measurements of chromicized sutures indicate that the tensile strength drops in a fairly linear fashion for a period and then maintains quite a constant level for a time after which there is a rapid loss until all strength is gone.

As we have found no loss in weight of the strands imbedded in the animal up to periods of 10 days, this characteristic shape of the curve cannot be explained as a consequence of loss of collagen material due to enzymatic activity, but other factors must be involved. In order to follow this problem more closely we have made a number of experiments where

TABLE IV.—EFFECT OF HEAT DENATURATION ON IN VIVO ABSORPTION OF PLAIN CATGUT

Heat treatment	Initial shrinkage temperature (degrees)	Initial tensile strength (Pounds)	Tensile strength after 7 days (Pounds)	Per cent residual wet tensile strength	Initial digestibility (per cent into sol.)	Digestibility after 7 days (per cent into sol.)
No treatment	61.5	7.7	6.3	83.3	7	27.3
Dried 16 hrs. at 100°C.	55.8	5.9	2.9	49.3	10.8	35.1
Complete sterilization process	47.5	7.0	1.2	17.0	70.1	97.8

we have examined the strands taken out of the animals in the following manner: the shrinkage temperature was measured, the strands were analyzed for chromium, and the relative tryptic digestibility was determined. The results of a typical experiment are presented in Table III.

It was found that there was a decrease in the chromium content and in the shrinkage temperature and an increase in the tryptic digestibility of the suture which paralleled the decrease in wet tensile strength after varying periods in the animal.

The dechromicization of the sutures is probably due to the transfer of the chromium from the collagen to other protein compounds in the surrounding tissue. This is in line with the observation of McLaughlin and Adams (8) who reported that, when chrome leather was immersed in water with unchromicized pieces of hide, there was a dechromicization of the tanned leather and a corresponding chromicization of the untanned pieces. Jenkins (6) and his co-workers have reported that a similar phenomenon takes place in living tissues when chromicized sutures have been imbedded therein. They observed that the phagocytic cells around the sutures took on the color characteristic of chromic catgut to such an extent that for some time after the catgut had been absorbed these chrome stained macrophages simulated the gross appearance of unabsorbed chromic catgut.

The relationship between chromium content, shrinkage temperature and tryptic digestibility has been discussed for *in vitro* experiments in the first part of this paper (Table I). The dechromicization which takes place in the tissue of animals has been shown to bring about a corresponding decrease in the shrinkage temperature and an increase in the digestibility of the suture; however, the increase in digestibility in the tissues is greater

than can be accounted for by the loss of chromium. We have shown in the first part of this paper that the degree of denaturation caused by the sterilization process has an effect upon the *in vitro* digestion of collagen sutures. Similar results were obtained by *in vivo* experiments (Table IV). A series of experiments was conducted in which the tensile strength and the tryptic digestibility of plain catgut sutures which had been heat treated to produce different initial shrinkage temperatures were measured after 7 days in animal tissue. The residual tensile strength and the relative digestibility were found to vary inversely with the initial shrinkage temperature. These experiments with plain catgut indicate that, while the products of metabolic activity in the tissue have a denaturing effect of their own upon the collagen which has an influence upon the residual tensile strength and the tryptic digestibility, the denaturation of the suture by the tissue fluids is influenced to a considerable extent by the heat treatment of the suture during the sterilization process. *We can here again emphasize the fact that the initial shrinkage temperature is as important as the degree of chromicization for adequate suture absorption.*

The increase in tryptic digestibility after chromicized sutures have been implanted in tissue is remarkable. While only about 7 per cent of the control strand went into solution under the experimental conditions, approximately 70 per cent was dissolved under the same conditions after 11 to 15 days in the animal (Table III). *For all practical purposes chromicized sutures can thus be considered non-absorbable at the time that they are imbedded in the animal, but through a process of dechromicization and denaturation they become absorbable.* As a result of these processes they lose tensile strength and gradually become more susceptible to the action of the tissue enzymes.

This mechanism seems to be ideal for a surgical absorbable suture, and any new absorbable suture material which may be introduced in the future probably should have properties which essentially conform to this mechanism.

#### SUMMARY

A study of the mechanism of absorption of surgical catgut and of some of its absorption characteristics has been presented. The relation of the tensile strength, shrinkage temperature, dechromicization, and tryptic digestibility of sutures before and after implantation in animals were studied. The experimental material presented leads to the following conclusions:

1. The absorption characteristics of the suture are determined not only by the degree of chromicization but also by the initial shrinkage temperature.

2. The wet tensile strength of a chromicized suture decreases in a fairly linear fashion for a time after which there is a period during

which there is little further loss of strength followed by a rapid decline until little or no strength remains.

3. A decrease in shrinkage temperature parallels the loss of tensile strength.

4. The chromium content of a suture decreases during the period in which it is in the tissue.

5. There is an increase in tryptic digestibility proportional to the time of implantation.

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# THE EFFECT OF THE ANTICOAGULANTS ON POSTPARTUM BLEEDING

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THE clinical use of the anticoagulants, both heparin and dicoumarol, has extended continuously since their original introduction. They are not only accepted agents in the therapy of intravascular clots, but their routine administration to surgical patients for prophylaxis has also been suggested and investigated (1, 2). The use of these drugs in puerperal thrombophlebitis has been limited, however, due apparently to a reluctance to administer them to patients experiencing vaginal bleeding, and the fear of postpartum hemorrhage. Pfeiffer and Sain specify that the bleeding of the puerperium represents a definite contraindication to the use of the anticoagulants, although they cite no studies to justify this statement. Davis and Porter have more recently reported the use of dicoumarol for thrombophlebitis occurring in the puerperium, but their data includes no estimation of the influence of the drug on the vaginal bleeding other than a statement that they observed no instances of gross hemorrhage in their patients, and we have been unable to find studies which record measurements of postpartum blood loss during heparin and/or dicoumarol therapy.

In the face of the known incidence of postpartum thrombophlebitis and phlebotrombosis (7), it was felt desirable to have more accurate information on this subject, and the present paper reports measurements of vaginal blood loss in patients receiving dicoumarol and heparin during the early puerperium.

*Materials and methods.* Blood loss studies beginning 1 hour postpartum and continuing throughout the period of hospitalization were made on 30 consecutive primiparous patients. All the patients had reached term and had uncomplicated labors with spontaneous delivery

or outlet forceps; episiotomy was performed on each. With the exception of the drugs under study, all of these patients were on a similar therapeutic program. Vitamin K was given to none of them; the same anesthetic agent (cyclopropane) was used in all deliveries; the oxytocic schedule included ergotrate (1/320 grain) intravenously following the delivery of the placenta, and the same dose administered by mouth 3 times a day for the first 3 postpartum days.

All perineal pads from each patient were collected over the period of time the patient was in the hospital. The pads of the preceding 24 hours were washed out daily in a measured amount of water, and a hemoglobin determination was made on the wash water. While this method was checked for accuracy with known amounts of venous blood distributed over several pads and dried an equivalent length of time, no attempt has been made in this report to reduce to grams of hemoglobin the readings obtained. The figures serve for accurate comparison between the group of controls and the treated patients, and the relative blood loss rather than the absolute blood loss has been our interest.

In addition to the blood loss data, prothrombin levels expressed as percentage of normal (Quick) were obtained on the control group and dicoumarol treated patients as well as the clotting times (Lee and White) on the heparinized patients and on controls.

*Controls.* The 11 patients who served as controls uniformly showed the marked elevation of prothrombin level which has been noted in the normal postpartum patient (6). Readings as high as 130 per cent were obtained (second day following delivery), and with the exception of one reading of 85 per cent on the third postpartum day, no patient fell below 100 per cent until after the fifth day. The average daily prothrombin levels among these patients, starting with the first post-

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partum day, were: 108, 111, 112.5, 113.25, 100.1, 109.2, 109, 101, 98 per cent. There were not enough patients in this group who remained after the ninth postpartum day to make the average figure of value. These prothrombin percentages are plotted graphically in Figure 1 as the dotted line (A). The solid line (B) represents the average blood loss of this control group during the same period of time.

**Dicoumarol.** Fourteen patients were given dicoumarol in doses adequate to depress their prothrombin levels to the therapeutic range. Three hundred milligrams were given during labor, 200 milligrams each of the first 2 days, and subsequent dosage was adjusted by the prothrombin determinations. In general, it was felt desirable to have the prothrombin percentage rising toward normal at the time of discharge, and the drug was discontinued 24 to 48 hours before the patient was to leave the hospital. The average daily prothrombin times for these patients, starting with the first postpartum day were: 90.7, 54, 33, 37.3, 20.6, 43.5, 37.7, 54.6, and 63 per cent. At least 12 of the patients are represented in each daily average except the first (6 patients), the 6th (10 patients), and 9th (7 patients). On these days technical difficulties or discharge from the hospital interfered with obtaining prothrombin readings on a larger group. The broken line (C) in Figure 1 records these levels.

The blood loss for this group is shown in the broken line (D) on the same chart. It will be seen that there is no significant difference between the average blood loss of this, the treated group of patients, and the controls (line B). The variation in the two curves on the first 2 days is not great and is not related to the period of prothrombin depression. The 5 day period that the prothrombin level was maintained below 50 per cent (i.e. more than 16.25 seconds undiluted) was perhaps brief compared to the period sometimes required for therapy, but the blood loss at the end of this time had dropped toward the nonmeasurable point, and we could see no advantage in prolonging the period of treatment. In one patient whose medications were continued through an oversight, the prothrombin level was maintained below 10 per cent (over 37

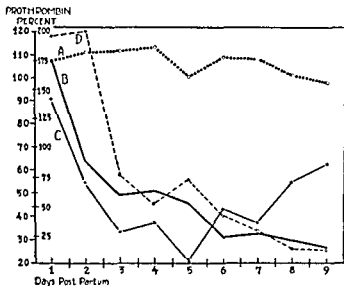


Fig. 1. The scale to the left represents the prothrombin percentage from 20 to 120. Curves A and C give the prothrombin readings for control and dicoumarol patients respectively. Curves B and D record blood loss figures for control and treated patients respectively plotted against the arbitrary scale (0 to 200) on the right.

seconds undiluted) her 7th, 8th, and 9th days postpartum. During this time the patient was ambulatory, but her blood loss was small and did not differ from that of the control group.

It can be noted from the results as recorded in lines B and D that if any given postpartum day is selected, the blood loss of the treated patients is not significantly more than, or is less than, that of the controls. The total blood loss, arrived at by adding the arbitrary figures for each day together, differs but slightly between the two groups, with the treated group having more. No correlation between blood loss and prothrombin rate could be noted in the dicoumarol treated patients; the greatest blood loss was on the second day, the lowest prothrombin percentage was on the fifth day.

**Additional observations.** Initially in the experiment when marked differences in blood loss were considered possible, hematocrit readings were taken every other day on all patients. It was felt that these would provide a more accurate index than would hemoglobin determinations of the effect on the patient of any excessive blood loss. There were no episodes of excessive blood loss, and the hematocrit remained comparable between controls and treated patients. There was no alternation in the degree of uterine involution at

the time of the patient's discharge from the hospital, nor were any toxic side effects noted.

Bleeding and clotting times obtained on the nursing babies showed prolongation in over one-third of the cases. These reactions were not consistent: in 2 cases both were prolonged, in the other 3 only the clotting time (capillary tube method) was increased. It is not felt that these studies performed on toe or heel blood are sufficiently delicate that the results would bear close scrutiny. In view of the report by Field, however, that rat litters nursed by dicoumarolized females showed hemorrhagic tendencies (7), it might be wise to consider weaning a baby whose mother required prolonged medication with dicoumarol.

**Heparin.** The action of heparin is more rapid, and there has been an increasing tendency in the presence of the indications for anticoagulant therapy to administer heparin the first 24 or 48 hours while the slower acting dicoumarol is having its effect (6). Accordingly, the patients in this study receiving heparin were maintained with prolonged clotting times for only a 24 hour period on either the first or the second day postpartum. Four cubic centimeters of heparin were administered intravenously, and beginning 4 hours later, the same dosage was administered by the intramuscular route every 4 hours. Clotting times were taken every 2 to 3 hours. Only 5 patients were followed in this manner, but the results in all were consistent, no patient varying more than 6 per cent from the average of the group, and it was felt that a definite index was obtained of the amount of blood lost by the heparinized patient.

**Results.** The clotting times of the controls checked during the first 48 hours postpartum were all normal (average  $7\frac{1}{2}$  minutes), and a significant puerperal alteration similar to that observed in the prothrombin time was not found. During the 24 hour period of treat-

ment in the heparinized group, this clotting time was maintained between 20 and 25 minutes with the exception of 1 patient who, on the dosage outlined, remained between 15 and 18 minutes. During the entire first postpartum week, the blood loss on these patients was the same as that of the controls. There was neither an immediate nor a delayed effect from the heparin administration. Two of the episiotomy wounds, however, developed hematomas, and one of these suffered a partial breakdown. Aside from this complication, the treated patients and the control group presented the same findings.

#### SUMMARY AND CONCLUSIONS

No patients with postpartum thrombophlebitis were treated, and the present note is not concerned with the therapeutic status of heparin and dicoumarol in this condition. The study was undertaken only to determine whether or not, should these drugs be indicated, the vaginal bleeding prohibited their use. Although the present series is not large, the patients have been followed carefully, and we are unable to find evidence that the anticoagulants significantly increased puerperal blood loss. The customary precautions in connection with the use of these drugs should be scrupulously observed (1), and the weaning of the baby is to be considered, but the data obtained would indicate that heparin and dicoumarol are not necessarily contraindicated in the postpartum patient.

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## TALC GRANULOMA

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**D**ESPITE many reports on the dangers resulting from the use of talc many surgeons remain skeptical and continue to use it as a powder for gloves. A study of the occurrence of granulomatous lesions produced by talc and their mode of production, therefore, seemed warranted.

The material reported in this paper is part of the data derived from a study of birefringence in tissues and an investigation of changes in tissues in human beings and in laboratory animals produced by doubly refractile foreign bodies, made visible by use of polarized light microscopy. In the main only the data on talc and the study of the reaction of tissue to talc will be recorded here, although other phases of the entire study will be referred to from time to time when they are pertinent.

### THE PROPERTIES, USES, AND DANGERS OF TALC

Talc is a hydrous magnesium silicate with a melting point of 1,380 to 1,530 degrees C. Commercially dispersed talc consists of mixtures of talc, serpentine, dolomite, or tremolite. Reports on the solubility of talc vary from 0.2 to 100 milligrams per 100 cubic centimeters because each investigator has a different interpretation of what constitutes a particle in solution. Talc moieties are complex and exert a definite effect on the environment without being in actual solution themselves.

The material leached out of a talc crystal during suspension is not the same as the parent substance. The degree of hydration of this derivative substance determines its toxicity. For example, a mole of alpha silicic acid may bind as many as 330 moles of water. The size, shape, and cleavage of a talc particle and its surface energy affect its so-called solubility. In the body, alteration of the pH and the presence of protein in tissue fluids alter the size and characteristics of the dispersed aggregates.

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To demonstrate these facts, talc and asbestos particles were placed in water, saline, body fluids and macerated tissues for 6 months. When these specimens were examined under polarized light, myriads of particles in brownian movement were seen in suspension. Particles of this dispersed size (0.5-10 microns) are the ones that do the greatest damage.

Talc is used extensively and may find its way into the body in many ways (Table I). The dangers of talc were first recognized by those interested in inhalation of this substance by miners and processors of talc (31). Extensive studies were made on the incidence and importance of talc pneumoconiosis (2, 7, 8, 12, 15, 19, 20, 27). The general impression was that talc produces a fine nonprogressive fibrosis.

Talc has been administered to animals by dusting (11, 12, 19) and injection into veins (12) and lymphatics (28). Its introduction into the testes of the guinea pig caused marked proliferative reaction. Tremendous variation was noted in the response of different tissues and of the same tissues in different individuals and species.

Pleural poudrage of talc was suggested for the production of selective pleural adhesions preliminary to operations on the lungs (4) but it was noted that it might increase susceptibility to tuberculosis (5). Talc has been rubbed on the pericardium in an effort to produce parasitic myocardial circulation (3, 24, 29, 30).

In 1933 Antopol reported 6 cases in which talc and lycopodium powder formed granulomas after operations. Since then granulomas and adhesions producing intestinal obstruction have been frequently attributed to talc introduced by surgeons' gloves (6, 9, 10, 13, 14, 17, 18, 21-23, 25, 26). It has been reported that 22.6 per cent of surgeons' gloves are perforated during operations permitting seeding of talc from the finger tips (32).

### CLINICAL DATA ON LESIONS PRODUCED BY BIREFRINGENT PARTICLES FROM VARIOUS SITES

Many talc granulomas were discovered by examination under polarized light of tissues obtained in cases in which there were adhesions, unusual scars, nodules, sinuses or granulomas, in which tuberculosis was in an unusual site or in which multiple operations had been performed.

TABLE I.—ROUTES, OCCUPATIONS, AND USES OF TALC WHICH MAY PERMIT ITS INTRODUCTION INTO THE HUMAN BODY

- I. Through air passages: inhalation for long periods of high concentrations of talc
  - A. Mining, processing, and packing of talc
  - B. Dusting rubber for prevention of deterioration and sticking
    1. In factories
    2. In operating rooms
  - C. Scouring and polishing with talc powders
- II. By mouth
  - A. Bleaching agent for barley
  - B. Cleansing agent for beans, coffee, corn, peas, peanuts, and barley
  - C. Dusting agent (with starch) and coating for molds and tables in manufacture of candy and chewing gum to prevent sticking
  - D. Packing and conserving agent for fruits and vegetables
  - E. Binder in pills and lubricant for tablet dyes
  - F. Filtering medium in refining and purifying sugar
  - G. Ingredient of tooth powders and tooth pastes
  - H. Ingredient in glazes, coating and filler for paper used for wrappings for foodstuffs
- III. By other routes
  - A. Coating of talc on vaginal and rectal suppositories
  - B. In antiseptic dusting powders used on wounds
  - C. In cosmetics and dusting powders for the skin
  - D. As a preservative and lubricant for rubber gloves used in operations

The mere presence of talc in a microscopic section was not considered significant because talc is frequently suspended in the air in operating rooms and because the specimen may be handled with rubber gloves in the laboratory and thus talc may be added during the preparation of the section. Gauze used to wrap specimens may add cotton fibers too. In fact, it was difficult to find a section without talc on it when the laboratory was adjacent to the operating rooms. Because of these facts, only those crystals which were associated with a definite surrounding inflammatory response were considered as significant. The nature of this work necessitated the elimination from consideration of any questionable particles and it was considered wiser to err on the side of rejection of any particle around which the foreign body response was not clear cut.

**Peritoneum.** In 100 consecutive surgical cases in which dense adhesions resulting from multiple previous operations on the abdomen were found, specimens of the adhesions were sectioned on the freezing microtome and studied by means of polarized light under the microscope. In 21 (21 per cent) of these cases talc crystals were found with a surrounding foreign body response. In 6 (6 per cent) a large amount of talc was present and the reaction was extensive. While the degree of reaction in these 6 cases was so great, and there was

no doubt of the part played by the talc in the production of the adhesions, the concentration of the talc and distribution of the reaction in the other 15 cases did not permit a definite conviction as to the rôle of the talc. Cotton lint fibers also were found in foreign body giant cells in these cases.

Nodular lesions of the peritoneum were examined next. In 4 cases definite talc granulomas were found. In these 4 cases small yellowish white nodules studded the peritoneum, mesentery, and omentum. In 1 of these cases lymphoid granules had contributed to the granulomas.

The tubercle-like appearance of the granulomas in these cases prompted us to re-examine tissue removed in cases in which a diagnosis of non-caseous tuberculosis of the peritoneum had been made. In 6 of the 102 cases of this condition in which lesions considered to be those of non-caseous tuberculosis were examined, the tubercle-like lesion had been produced by talc. In 5 other cases in which talc was not present, some of the tubercles apparently were actually foreign body responses to cholesterol esters contained in the nodule. Thus by the use of polarized light microscopy, the talc and cholesterol ester crystals, which were obscure on routine examination, became apparent. During examination of peritoneal lesions 6 cases were found in which birefringent vegetable fibers, originating from a previous perforation of a peptic ulcer, had formed granulomas. These were made obvious by the use of polarized light.

When concomitant trauma, abrasion, and infection had occurred, the talc if present in high enough concentration had produced dense adhesions with proliferation of a moderate amount of fibrous tissue. The granulation tissue in the adhesions was well vascularized. There was not enough fibrous tissue to cause obliteration of the vessels such as occurs in granuloma caused by silica. When simple inoculation of the talc had occurred with little infection or trauma, the talc tended to form plaques and nodular lesions were produced rather than dense adhesions.

These findings suggest that great caution should be observed about accidentally introducing talc into the peritoneal cavity in cases of tuberculous peritonitis. It would seem that talc may accelerate the progress of a tuberculous infection of the peritoneum.

**Scars, sinus tracts, and lesions of skin.** Nodules developing in scars left by operations are a source of concern to the surgeon and the patient. The patient is anxious about the cosmetic effect particularly if the scar is about the face and neck



from the prolonged use of suppositories dusted with talc, dusting powders, and other medications containing talc. Although the intact mucus membrane will not adsorb talc, the conditions prompting the prolonged use of rectal and vaginal medication are usually associated with erosions, ulcerations, and fissures. These granulating surfaces may adsorb talc particles and include them in a foreign body reaction.

In 25 consecutive cases in which biopsy revealed chronic cervicitis, the tissue removed was examined under the polarized light microscope and talc was found to have caused some reaction in 2 of them. In neither of these cases was the degree of reaction sufficient to account for the entire inflammatory response but it certainly may have been a factor in causing the persistence of the lesion. In these 2 cases, the lesion was suspected of being malignant on gross examination.

Two hundred specimens of inflammatory rectal mucosa were examined after removal in the course of hemorrhoidectomies. Although talc was found in many of these tissues, none of them showed a marked foreign body response and only 12 showed a minor foreign body response to the adsorbed talc.

In addition 2 definite talc granulomas were found in which rectal stricture was so marked that radical resection was performed.

Granulomas produced by foreign bodies such as oil or talc, introduced into the rectal tissues by injection for the treatment of hemorrhoids, by a gloved finger covered with talc or petroleum jelly, or suppositories aided by trauma, have on occasion been considered as malignant by most experienced diagnosticians. Biopsy may reveal a nonspecific inflammatory picture or the presence of pseudotubercles may suggest tuberculosis. Time can be saved by the examination of fresh-frozen sections under polarized light. On this examination the talc crystals as a center of the foreign body reaction are immediately apparent or the oleoma is self-evident. If the pathologist does not give such a definitive diagnosis, the patient will be subjected to repeated biopsies to rule out a malignant lesion. The granuloma may cause marked obstruction and radical therapy may be necessary.

*The gall bladder.* The finding of the following talc granuloma in the gall bladder was accidental and not by intentional investigation. It was encountered in a study of the cholesterol esters in the gall bladder.

Eleven years previously the patient had undergone cholecystostomy for cholecystitis with cholelithiasis. Little relief resulted and postoperatively the patient complained

of pain in the epigastrium and a tender mass in the right lower quadrant of the abdomen. Because of the persistence of these symptoms for 11 years, cholecystectomy was performed at which time dense adhesions to the stomach and colon were encountered. The wall of the gall bladder was markedly thickened and the pathologist suggested that a sarcoïd of the gall bladder might be present. The adjacent lymph node was considered tuberculous. On re-examination with the aid of polarized light it was found that the gall bladder and lymph node were loaded with talc and cholesterol ester crystals. The close-packed pseudotubercles closely resembled a sarcoïd lesion (Fig. 3).

The type of cholecystostomy tube used 11 years before was not known but it probably carried the talc in to the gall bladder and in all probability some petrolatum jelly too.

*Gastroenteric stomas.* Sixty specimens from the walls of excised malfunctioning gastroenteric stomas were subjected to examination by means of the polarizing microscope. In 8 (13.3 per cent) of them a large amount of talc was found in the wall around the stoma and a marked foreign body reaction was associated (Fig. 4). In 8 others a limited amount of talc was found. Foreign body reactions to the suture material used in the creation of the anastomosis also were present.

The talc in these cases may have been derived from the rubber-shod clamps used in making the anastomosis. The part the talc plays in malfunction of a gastroenteric stoma of adequate physical size is a matter of conjecture and a positive opinion would be perilous. Some evidence of the profound effects on the intestinal wall of intramural talc granulation tissue can be derived from the experimental work on the production of fecal fistulas which will be reported later in this paper.

It was deemed wise to compare this series in which the gastroenteric anastomosis was taken down because of poor function with a group of cases in which it was excised because of an anastomotic ulcer. In this latter group the function of the stoma was usually good. Tissue from the site of 100 such stomas was examined; the tissue from 4 (4 per cent) contained a marked amount of talc and from 3 a slight amount. The greater incidence of talc at the site of the malfunctioning stomas suggests the possibility that the granulomatous tissue in the wall of the stoma contributed to the poor function.

#### NONCASEOUS TUBERCULOSIS OF ILEUM AND REGIONAL ENTERITIS

From the findings presented thus far it can be seen that on occasion talc granuloma may simulate tuberculosis and that it may be diagnosed as tuberculosis. While large talc crystals can be seen in ordinary light when the field is darkened, particles between 0.5 and 10 microns in diameter

which cause most of the damage can be seen clearly only with the aid of polarized light. In view of the number of substances and products of inflammation which may produce pseudotubercles in some species (Table II), the unsupported morphologic diagnosis of hyperplastic noncaseous tuberculosis in cases in which tubercle bacilli are not demonstrable by staining, culture or guinea pig inoculation is subject to question. Many pathologists now call such lesions sarcoids.

So-called regional enteritis often consists of hyperplastic tissue in which there are pseudotubercles. It occurred to us that before 1932 many lesions now called "lesions of regional enteritis" would have been classified as hyperplastic noncaseous tuberculosis. In spite of the controversial nature of the problem it was decided to re-examine under polarized light the specimens of hyperplastic tuberculosis of the ileocecal region seen at the Mayo Clinic. By examination of multiple sections of the specimens and review of the history in 198 of these cases, the impression that a large number of these would be considered cases of regional enteritis in the present day was verified. One aspect of this problem is of interest in this study. In 49 of the 198 cases of so-called hyperplastic tuberculosis birefringent crystalline material was found. Extensive study of specially stained sections failed to reveal tubercle bacilli in any of the tissue available for study in these 198 cases. In 33 of the 49 cases, the amount of the crystals was large and the reaction appeared to be result of the presence of the crystals (Fig. 5). In 16 of the cases the amount of the crystals was small, and no definite conclusions could be drawn about their relation to the reaction. The magnitude of birefringence of the crystals in all 49 cases was high and negative in sign. As far as the petrographic analysis could go, the crystals resembled talc crystals. They were subjected to incineration study (Fig. 6) and the silicate nature was verified by comparison with adjacent serial sections. The crystals were not calcium deposited by a tuberculous infection for the birefringence of these apatite crystals is of low magnitude and the sign is positive. Furthermore, calcium salts, when stained with polychrome methylene blue take on a blue color, and do not provoke a foreign body reaction. Efforts to identify these crystals were fruitless.

Experimental investigation was limited to the roundabout method of trying to reproduce the lesion. Since only half of the patients had had previous operations involving the right lower quadrant of the abdomen, it could not be assumed that the crystals had been accidentally placed in the abdomen by the surgeon at the first operation.

TABLE II.—SUBSTANCES WHICH HAVE BEEN REPORTED TO PRODUCE STRUCTURES RESEMBLING MORPHOLOGIC TUBERCLES WITHOUT CASEATION IN SOME SPECIES\*

Bacteria: *Mycobacterium tuberculosis*; *Mycobacterium leprae*; *Malleomyces mallei*; *Pasteurella pestis* and coal dust impregnated with *Bacillus subtilis*; *Pasteurella pseudotuberculosis*; *Brucella abortus*; *Brucella melitensis*; *Pasteurella tularensis*.

Fungi: *Aspergillus*; *Blastomyces*; *Actinomyces*; *Trichophyton*; *Coccidioides* and *Actinomyces asteroides*.

Plants: *Lycopodium* (club moss); finely divided cork and pepper.

Protozoa:

Sporozoa: *Sarcosporidia*.

Spirochetes: *Treponema pallidum*.

Platyhelminthes:

Nematodes: *Ascaris*; *Filaria*.

Trematodes: *Schistosoma mansoni*.

Cestodes: *Echinococcus*.

Chemical and derived substances: mercury; talc; fibrous sericite; powdered dry silica gel; cholesterol esters; oil of turpentine and euphorbium; the lipid, phosphatide or protein extracts of tubercle bacilli; lipid extracts of liver, grass bacilli or colon bacilli, and mineral oils.

\*Sarcoid, acne rosacea, and other skin lesions which may represent allergic responses to the tubercle bacilli, and keratinizing squamous cell epithelioma sometimes resemble noncaseous tubercles.

*Study on animals.* An attempt was made, therefore, to determine whether the crystals could have been adsorbed from the gastrointestinal tract. Six adult white rats were selected for this study. They were fed for 30 days on stock ration plus talc crystals so that 10 per cent of the ration consisted of talc. The diet was then changed so that it contained 20 per cent talc and this ration was fed for 12 days more. There was no change in the bowel habitus and the rats showed no ill effects from the high concentration of talc. They seemed to thrive on it. Polariscopic examination of the stools revealed that they were loaded with talc. Feeding of talc was discontinued after 42 days and the rats were allowed to eat straight stock ration for 9 days so that the talc in the gastrointestinal tract would have a chance to empty out. Then the animals were killed and necropsy performed. Fresh frozen sections were made of all the organs and were examined by means of polarized light.

On opening the abdomen, the peritoneum appeared normal and there was little of note other than a slightly thickened mesentery and marked prominence of the Peyer's patches along the terminal part of the ileum. Sections of the terminal part of the ileum showed segments in which there was infiltration of the villi by lymphocytes and eosinophils (Fig. 7). The connective tissue between the muscularis mucosae and the tunica muscularis showed more birefringence than it nor-



mally does. The muscle layers were normal except for the infiltration of lymphocytes in the regions of vessels and lymphatics. There was moderate hypertrophy of the nerve tracts and ganglionic plexuses. The lesion diminished in the proximal portion of the ileum and both the jejunum and stomach showed little change. Examination of the colon gave negative results.

Birefringent talc could not be found in the intestinal wall or other viscera. The liver was normal except for a few regions in which small local hemorrhages were found. In the tubules of the kidney there was found similar evidence of the rupture of a few capillaries. There was slight early acute glomerulitis (Fig. 8). Polymorphonuclear leucocytes were present in some glomeruli in small numbers and occasionally the lesion had extended and obliterated the tuft which was replaced by a granular mass studded with pyknotic nuclei. There was some hyperplasia of the germinal centers of the spleen (Fig. 9) but the most prominent change was seen in the blood sinuses. These were distended with red blood cells and lymphocytes. The eosinophils were moderately increased. The amount of connective tissue was more than usual. Some areas showed extensive deposits of hemosiderin.

The interpretation of these minimal findings is difficult. The initial dose of talc was intentionally high, yet it was doubled because the rats seemed to thrive on the first dose. Most of the effects may have been produced mechanically by the large amount of talc in the intestinal contents. But talc is not particularly hard. It is softer than the bismuth, calcium, and barium salts that occasionally find their way into the intestinal tract. It was hoped that the local mechanical effects would have cleared up in the 9 days between the last dose of talc and the termination of the experiment. No evidence of birefringent talc was found in the walls or lumen of the gastrointestinal tract. Similarly none was found elsewhere in the body. Probably a longer interval after the last dose of talc would have been more satisfactory. But this much can be gleaned from the experiments. The lesion, whatever its mechanism, was segmental and most prominent in the terminal part of the ileum. This is the site of predilection of many of the granulomatous lesions of the intestines. If the lesion was produced by a colloidal fraction leached from the talc, the inflammatory reaction would be the response anticipated and its locale would be the terminal portion of the ileum. The slight endothelial reaction present in the kidney and to a lesser extent in the spleen and liver was suggestive of the lesions that have been described following

the injection and oral ingestion of fresh silicic acid. The abundance of eosinophils in the inflammatory response is an occasional characteristic of lesions produced by talc. There was no evidence of the absorption of any particles large enough to be visualized by polarized light but colloidal particles are not visible. The rats did not show symptoms or change in bowel habitus. However, the changes in the kidneys suggest that a colloidal fraction of talc may be absorbed and excreted via the kidneys.

#### RÔLE OF TALC IN PERSISTENCE OF FECAL FISTULAS AND RESPONSE OF ILEUM TO INJECTION OF TALC

In a previous report (16) on 408 surgically treated fecal fistulas, it was found that talc, placed in the abdomen during the course of previous operations, had produced talc granulomas in the walls of some of the fistulas. Fifty of the more persistent fistulas, in which there was no apparent cause for the persistence of the fistulas, were selected for detailed microscopic study. In this smaller group, talc was demonstrated in 4 fistulas (8 per cent). Because of the relation of the talc to the inflammatory reaction, and the organization of the fistulas, it was assumed that the talc was a factor in maintaining the fistulas.

In order to test the validity of this assumption and incidentally to study the pathogenesis of talc granuloma, we decided to determine whether talc in the serosa of the bowel would alter the natural tendency of the proximal limbs of isolated loops of intestine to close. It was not the purpose of this work to study the effect of talc alone but of talc plus infection.

The same batch of talc was used throughout this work for uniformity. It was not fresh since it was the variety used in the operating room. A 1 per cent suspension was made up and sterilized. Since the talc was in suspension, the activity was less than that of the dry fresh dust.

Six dogs were subjected to operation under ether anesthesia with aseptic technique. A midline abdominal incision was made. About 40 centimeters of the distal portion of the ileum was selected for isolation. Suitable vascular arcades were identified and the marginal vessels were cut between ligatures. The bowel was cut between clamps and the 40 centimeters of ileum with its blood supply intact was isolated. Continuity of the ileum was established by side-to-side anastomosis (Figs. 10 and 11).

The isolated segment of ileum was divided between clamps into two halves 20 centimeters long. Two stab wounds were made through the abdom-

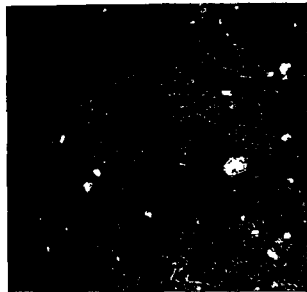


Fig. 1. Talc granuloma in scar of forehead which originally was considered as noncaseous tuberculosis because of the characteristic hard tubercles and extensive fibrosis. Polarized light revealed a wide distribution of talc ( $\times 88$ ; polarizer at  $\frac{1}{2}$  extinction to show surrounding lesion).



Fig. 2. Talc granuloma in an inflammatory sinus tract from the abdominal wall. There was extensive fibrosis ( $\times 132$ ; polarizers at  $\frac{1}{2}$  extinction to show background).

inal wall on each side of the incision as exits for the two ileal loops thus created. The peristaltic direction was marked carefully. The ends of the loops were brought out through the appropriate stab wounds. The ends of the more proximal of the two loops were brought out to the right (right side of the dog) of the incision (Fig. 12a and b) with proximal end cephalad and distal end 5 centimeters caudad. The more distal of the two loops was brought out to the left of the incision (Fig. 12c and d) in a similar manner again maintaining peristalsis in a caudad direction. The proximal limb of the right loop and the distal limb of the left loop were treated with talc; this procedure thus permitted each dog to act as a control on itself. Two cubic centimeters of the 1 per cent talc suspension was injected subserosally as follows: A syringe attached to a short bevel 27 gauge hypodermic needle was used. Multiple punctures were made in a segment 1 centimeter long of proximal end of right loop (Fig. 11a) and the distal end of the left loop (Fig. 11d). A total of 40 milligrams of talc was used in each dog. A few wheals were raised in the parietal peritoneum near the proximal end of the proximal loop (a in Figs. 11 and 12). Small amounts of talc suspension invariably escaped into the peritoneal cavity. Control punctures were made in the untreated ends of the loops. The abdomen was closed and the four projecting ends of the two loops were fixed to the abdominal wall by two catgut sutures (Fig. 12). The operative trauma was intentionally extensive. This was done in an attempt to reproduce con-

ditions as nearly as possible like those in the cases in which fecal fistulas occurred, for questioning of the patients who had postoperative fecal fistulas had revealed that the original operation was frequently an emergency procedure and there was a stormy postoperative course owing to peritonitis.

Postoperatively all the animals showed signs of peritonitis. Three weeks after operation induration about the intestinal stomas subsided and it was possible to begin observations. Six weeks

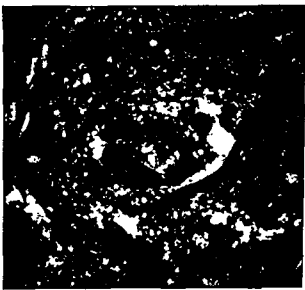


Fig. 3. Sarcoid of the gall bladder was suspected at first; actually the tubercles represent a foreign body response to both talc and cholesterol esters. Several cholesterol ester liquid crystals may be seen in the gallbladder; nearer the mucosa there were talc crystals also. Both substances were found in the sentinel lymph node ( $\times 97$ ; polarizer at  $\frac{1}{2}$  extinction to show surrounding lesion).

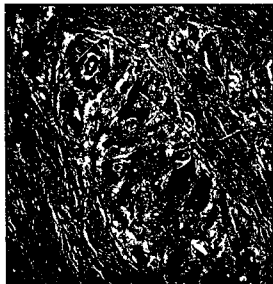


Fig. 4. Talc granuloma found in a gastroenteric stoma dismantled and excised because of malfunction ( $\times 117$ ; polarizer at total extinction).

after operation it was obvious that the treated loops were open and the untreated loops were closing. Although it was anticipated that the distal limb on the right would remain open because of peristalsis, it closed. This probably resulted from the fact that its proximal end had been treated with talc and was not closing. Eight weeks after operation the untreated ends were marked by a firm nodule under the skin, and on the treated ends the stomas seemed stabilized. The open ends had clean everted lips of mucosa.



Fig. 6. Incinerated section under polarized light showing a tubercle around birefringent crystals in the ileum ( $\times 110$ ; polarizer at total extinction).

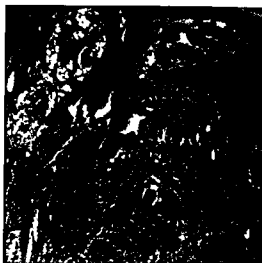


Fig 5. This lesion in the ileum on first study seemed to be noncaseous tuberculosis. The relation of the birefringent crystals to the reaction and their inclusion in foreign body giant cells and histiocytes suggest that they are the cause of the pathologic picture rather than the result of an inflammatory process. None of these crystals was visible in ordinary light ( $\times 48$ ).

Four of the animals remained ill throughout the study and 2 regained their original activity. One animal was killed 96 days after operation and the others, 140 to 150 days after operation. At necropsy many adhesions to the sites of injection of talc were found. Two of the animals, both of which had been sick, had internal fistulas. These fistulas apparently had caused their chronic illness and loss of weight. One of them had multiple fistulas around the side-to-side anastomosis (Fig. 13). In 4 of the dogs the isolated ileal loops were the same size as the normal ileum but their walls were thickened. In 2 of the dogs the proximal loop, which had received an injection of the talc in the proximal end, was dilated and thickened to four times normal size. The distal ends of all the right loops had closed despite the fact that peristalsis ran in that direction. The closing of the distal ends of these right loops of intestine is probably the best evidence of the effect of talc in the wall of the intestine. Not only did it maintain patency in the end most likely to close but it permitted closure of the end most likely to remain open (Fig. 14). The factor that ordinarily keeps the distal end open is probably the mucus brought down by peristalsis. When proximal end was maintained patent by the talc in its wall, spontaneous closure of untreated distal end was permitted. The closed right distal and proximal limbs were represented by a fibrous cord in the abdominal wall. The mesentery was thickened and matted.



Fig. 7. Infiltration with leucocytes and lymphocytes of the terminal part of ileum of the rats fed talc.

No talc nodules were seen grossly on the peritoneum of these dogs. In the regions in which the talc was placed, however, inflammatory granulation tissue was present. Examination of the other organs did not reveal any abnormalities. The anastomosis in the ileum in each animal was well healed and functioning although 2 animals showed the internal fistulas mentioned. Infection was general and operative trauma extensive.

Frozen sections were made of the organs and they were examined with the aid of polarized light. The mesentery and areas of lymphatic drainage for the sites of injection of talc were examined. No talc was found in these nodes or anywhere else but at the sites of injection or spilling of talc. With the small amounts of talc injected, there was little opportunity for its transport from the site of injection.

Although no visible talc was found to have been transported to the lymphatics of the mesentery there was definite evidence of the extension of the inflammatory reaction. The nodes of the mesentery showed marked hyperplasia with proliferation of the reticulo-endothelial cells of the sinuses such as is seen in mesenteric lymphadenitis. The spleen showed marked hyperplasia of the germinal centers with an increase of eosinophils. There were heavy bands of collagenous connective tissue along the blood vessels (Fig. 15). No birefringent talc was seen in the spleen or the liver. The hepatic lymph nodes were enlarged however.

The intestinal wall at the site of the injection of talc contained chronic granulomatous lesions. The villi were thickened and contained eosinophils,

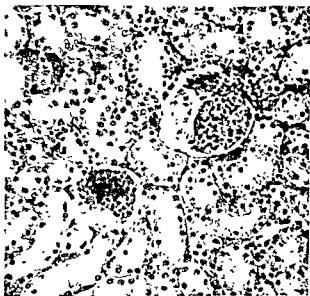


Fig. 8. The kidney of the rat showing early minimal glomerulitis with hemorrhage and slight infiltration of leucocytes (X176).

plasma cells, and histiocytes. There was hyperplasia of lymph follicles and muscle elements. The nerve tracts and ganglia in the intestinal wall near the site of injection were enormously hypertrophied and formed large masses. When larger talc particles were found (Fig. 16) in clusters, the lesion consisted of large numbers of foreign body giant cells surrounded by epithelioid leucocytes. The talc crystals distributed in the connective tissue tended to adlineate themselves with fibroblasts and collagen fibers. Many nodules of a



Fig. 9. Slight hyperplasia of the germinal centers in the spleen of a rat. There were areas of congestion, hemorrhage, and deposits of hemosiderin. Many small foreign body giant cells may be seen (X172).

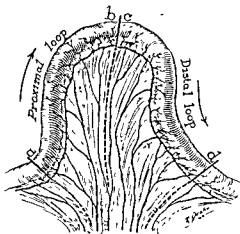


Fig. 10. Diagram showing the selection of the two loops from the terminal ileum and the manner by which the peristaltic direction was maintained so that the second loop would act as a control for the first loop; *a* and *c* are proximal ends; *b* and *d* distal ends.

cellular variety of fibrous tissue were present. These were particularly characteristic of the talc lesion in dogs (Fig. 17). Unlike the silicotic nodule, many fibroblasts were present and some capillaries crossed the nodules. There seemed to be little tendency for this type of fibrous tissue to close off its blood supply and little collagen and no

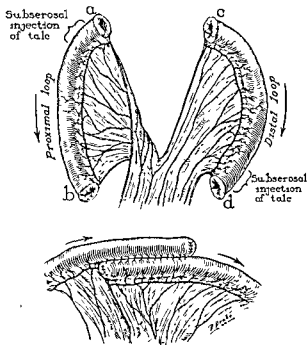


Fig. 11. Talc was injected subserotonically at *a* and *d*. Control needle punctures were made at *b* and *c*. The loops were placed so that their peristaltic direction was caudad. Anastomosis in ileum is shown also.

hyalinization were noted. The connective tissue showed no obvious organization. On examination with polarized light no talc crystals were found in this region but when the section was incinerated, small birefringent specks were found uniformly distributed throughout the connective tissue. The areas of desmoplasia were circumscribed by thin layers of collagenous connective tissue which in turn were surrounded by many lymphocytes. The connective tissue between the tunica muscularis and the muscularis mucosae was highly birefringent. This layer is birefringent in the normal intestine but the magnitude of birefringence was increased in these animals. Sections of ileum in the region injected with talc revealed a picture that resembled strikingly the picture found in regional enteritis.

As a result of this study on isolated loops of intestine together with information derived from the data considered thus far a possible explanation for the chronicity and progression of regional enteritis is as follows: It is known that some foreign bodies while producing a minor reaction themselves tend to sustain the inflammatory response to infection for long periods despite subsidence of the infection. Birefringent crystals have been

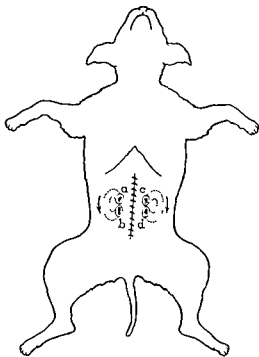


Fig. 12. Position of the four emerging limbs of the ileum on the dog's abdomen. Stomas at *a* and *d* were treated with talc and were the only ones to remain patent. Peristalsis was caudad in both loops and if talc had not been injected both *b* and *c* would have remained patent.





Fig. 15. Section of the spleen of an animal which had received subperitoneal injections of talc. Hyperplasia of the germinal centers is marked and the collagenous connective tissue is increased ( $\times 44$ ).

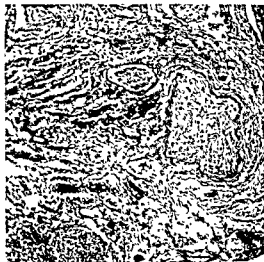


Fig. 16. Response of the ileum to larger crystals of talc that were injected. The crystals are enclosed by histiocytes. Hypertrophy of the nerves, thickening of the vessel walls, and moderate fibrosis should be noted. In the lower left corner there is an infiltration with lymphocytes ( $\times 53$ ).

ical factors in the foreign body dust and the local region of host tissue are subject to innumerable variations which control the type of reaction. The production of lesions morphologically resembling tubercles may require certain fixed conditions. Epithelioid cells may be derived from monocytes by the phagocytosis of colloidal or finely divided foreign material, with certain

physicochemical characteristics, which does not destroy the cell. It is possible too that it requires a longer time than was allowed in this study, for the development of tubercles in dogs after the injection of talc. An active dry dust may be essential or the type of bacteria in the lesion may modify the lesion.

An early impression that trauma and infection played a leading part in the determination of the morphology of the talc lesion was not completely substantiated. In the same animal, adjacent regions showing extreme variation in the response were found. In some regions, the talc provoked a marked inflammatory response with many foreign body giant cells while in other regions it was found distributed in the connective tissue spaces simply engulfed in histiocytes with little surrounding reaction.

*Lesions 3 to 5 days after injection.* The immediate reaction to talc was necrosis of the cells in the region of the injection. At this time also bacterial infection was at its height. At the site of injection instead of the leucocytic response which bacteria alone would have produced, all cell outlines were lost and the field was strewn with chromatin debris. Small regions resembling caseous necrosis were found which were surrounded by polymorphonuclear leucocytes and an increased number of eosinophilic elements. An occasional crystal of talc was engulfed by histiocytes. The reaction was uniform at this time and not subject to the variation that was found at later periods. It rep-



Fig. 17. A nodule of a rather cellular type of fibrous tissue produced in the ileum of the dog by the injection of talc crystals. Nerve fibers between the muscle coats are increased and the thickening of the muscular coats is probably brought about by a decrease in the length of the ileum which contributes to the thickening of the intestine. Regional enteritis shows a similar muscular hypertrophy ( $\times 62$ ).

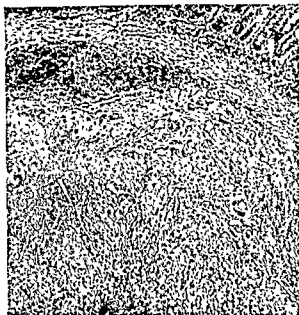


Fig. 18. Lesion in the ileum of the dog 19 days after the subperitoneal injection of talc. The response is inflammatory. Polymorphonuclear leucocytes, lymphocytes, and histiocytes are abundant ( $\times 47$ ).

represented the reaction to the more active talc molecules on the surface of the crystals and those already dispersed in the suspension fluid.

**Lesions 19 days after injection.** At this phase the nature of the response was determined by the size and distribution of the particles. Although particles of various sizes were distributed uniformly in the suspension at time of injection 19 days later the particles seemed to have been sorted by transportation.

The reaction around small particles up to 3 microns in diameter, about the size range of bacteria, was predominantly inflammatory (Fig. 18). Polymorphonuclear leucocytes, lymphocytes, and histiocytes were numerous. Eosinophils and some plasma cells were present. Lymphocytes were found in large masses. While fibroblasts were present there was no evidence of added fibrous tissue.

When the particles were moderate in size, approximately 3 to 12 microns in diameter, the crystals were engulfed by larger histiocytes. Little surrounding inflammatory response and no polymorphonuclear leucocytes were found. A large percentage of the crystals were parallel to the planes of the connective tissue found in the region. Similarly, the particles in histiocytes were usually situated in the long axis of the cell.

Larger particles of talc, measuring more than 12 microns in diameter, were engulfed by foreign body giant cells. When the particle was too large, only a portion was contained in the foreign body



Fig. 19. Lesion produced by talc in the abdominal wall after 96 days. There is a proliferation of a cellular variety of connective tissue in bundles. The larger crystals in the center are engulfed by foreign body giant cells ( $\times 71$ ).

giant cell. There were no surrounding fibroblasts or leucocytes.

**Lesions 96 days after injection.** In the dog at this time the talc granuloma was characterized by peculiar desmoplasia and did not resemble granulomas found in man. The desmoplasia consisted of large nodular masses of a cellular type of fibrous tissue (Fig. 19). There was a limited amount of



Fig. 20. Edge of a mature fibrous tissue nodule 140 to 150 days after injection of talc. The fibrous tissue is cellular and the capillaries are abundant. The surrounding connective tissue shows more fibrous and collagenous elements. This response occurs in dogs but in human beings a pseudotubercle forms ( $\times 44$ ).



fibrillar tissue with little apparent arrangement. This fibrillar tissue was surrounded by a thin band of collagenous connective tissue. No visible talc crystals were seen in this nodule of loose connective tissue, but after incineration a dispersed form of talc crystals was found which was not made visible by polarized light in the fresh frozen section. After incineration these fine birefringent specks were easily visible. They were probably the bodies that were seen in brownian movement in the solubility studies.

Although no talc crystals were visible in fresh frozen sections in the nodular masses of loose connective tissue, talc crystals were visible in fresh frozen sections of tissues around the nodules. Large particles were engulfed by foreign body giant cells and the reaction about them was stationary. In the peritoneal adhesions examined, granulation tissue was found which was well vascularized and contained many particles of talc. Lymphocytes, histiocytes and eosinophils filled the regions between the capillary tufts and the fibroblasts were contained in a loose fibrillar tissue. Inflammation seemed to persist at this late date in these adhesions despite the fact that the inflammation in the peritoneal cavity in general had long since subsided. When nerves were found adjacent to the site of injection of the talc, particularly in the intestinal wall, hyperplasia of the nerve fibers and ganglion cells was seen.

*Lesions 140 to 150 days after injection.* The lesion had not changed from the one found earlier except for an increase in the collagenous connective tissue surrounding the loose fibrous nodules (Fig. 20). The loose fibrous tissue usually contained a few capillaries and occasionally larger vessels were seen crossing into the nodule.

Some of the characteristics of talc granuloma noted in this study of pathogenesis have suggested the use of talc from time to time when well vascularized new tissue is desired. It has been used to provide a parasitic blood supply for the heart and to create adhesions in the pleural space. It may be of value in producing a parasitic blood supply in cases of cirrhosis. In addition to these therapeutic uses of talc, its ability to maintain the patency of fistulas might be of value in establishing intentional biliary fistulas. There are many situations where a firm well vascularized tissue, which will not contract, is desired.

#### PRODUCTION OF GRANULOMAS BY FOREIGN BODIES WITH EMPHASIS ON TALC GRANULOMA

In view of the widespread use at operations of the dry glove technique which calls for the dusting with talc of gloves used by surgeons it is surprising

that the injurious effects of talc are not seen more frequently. Evidence that the response of various individuals to foreign bodies differs greatly is encountered frequently. Many miners work for years in high concentrations of silica dust without the development of clinical silicosis whereas others show signs of silicosis. When symptoms do appear they usually are noted from 6 to 30 years after first exposure. Fats and oils are constantly being aspirated into the lungs; oil when it is a vehicle for some drug is injected frequently, radiopaque oil often is introduced for diagnostic purposes, and vaselin drains and paraffin have been used extensively for many purposes, yet a granuloma develops only occasionally. While the work on animals has revealed much less variation in the response to foreign bodies from animal to animal, even there the responses differ considerably. Concomitant infection and trauma seem to modify the individual response. The change in the pH of the tissue fluids (which are usually somewhat alkaline) produced by infection, may be a factor in altering the individual's response to foreign bodies.

When particulate insoluble foreign matter is introduced into the body, the initial reaction to the trauma of insertion is inflammatory. Substances which are initially toxic create such cellular proliferation and edema that the substances are shed by the formation of abscess or slough. Particulate substances which produce granulomas first invade the tissues insidiously. The presence of infection may modify events, so that the physicochemical properties of an almost innocuous foreign body can cause a foreign body reaction which in turn results in the pathologic changes of granuloma. The proliferation and phagocytic activity of the histiocytes increase. The purposeful aspect of this process is the provision of a barrier between the constantly changing tissue fluids and the foreign body. This barrier prevents the continuous leaching of the particle. The evidence for this assumption is the fact that if the particle has a jagged end, that end is surrounded first. The small particles are completely engulfed and the larger particles are isolated by many cells which ultimately fuse. In this phase of the process the toxic action of the fraction of the particle leached out within the engulfing cell determines the future course. If the toxic action is lethal, the field will be strewn with the pycnotic vestiges of phagocytic cells. Fresh phagocytes must take up the foreign body anew. If infection is still active, phagocytic activity is less efficient; for when a histiocyte is performing one function, its ability to do others is reduced. The relative strength and

character of each of these factors determine whether the end-result is an abscess, a mass of lymphocytes, plasma cells or histiocytes, an epithelioid reaction with formation of so-called tubercles or fibrosis.

Tubercle bacilli have the peculiar property of acting as foreign bodies or inflammatory organisms at various times in the history of their residence in tissues. In one individual they produce a proliferative lesion and in another an exudative one. As time passes, if the activity of the tubercle bacilli is successfully slowed, an exudative lesion may change to a proliferative one by the increased production of limiting fibrous tissue. When silicosis and tuberculosis coexist, although fibrosis is a prominent feature at certain stages, a change in the physicochemical status of the tissue may permit acceleration of the growth of the tubercle bacilli. In addition, the fibrosis due to silica is so extensive that it interferes with the disposal mechanism of the tissue. Talc does not stimulate the production of fibrous tissue to the extent that silica does but the presence of infection and talc will cause minimal, nonprogressive fibrosis which provides a limiting or restricting barrier. In rare instances talc plus infection will produce a moderate degree of fibrosis. Lesions similar in many respects to talc granuloma result from crystals of cholesterol esters with the formation under suitable conditions of pseudotubercles. These lesions are frequently diagnosed as tuberculosis at first glance. The use of polarized light microscopy makes the cause obvious. A quiescent foreign body reaction may be activated by the addition of infection or trauma. When fatty tissues are involved, infection or trauma may cause the release of irritating free fatty acids and cholesterol esters. These in turn further aggravate the foreign body reaction.

In the silicotic nodule unbridled fibrosis may occur after which contraction of the fibrous tissue creates an avascular nodule. In this avascular nodule basket-weave laminations of collagen at first form discrete nodules. Added infection will induce a conglomeration of these nodules. Hyalinization, which is common as the mass of fibrous tissue increases in size, is accompanied by an increase in the natural silicate in the collagen. Tuberculous lesions show caseation, necrosis, and calcification. The pseudotubercles seen in so-called regional enteritis do not undergo these changes but pyogenic centered tubercles are seen in which the centers are filled with polymorphonuclear leucocytes. Talc, cholesterol esters, and some other foreign bodies produce pseudotubercles which, although they resemble early tubercles, do

not show caseation, calcification, or pyogenic centers. The lesion produced by these foreign bodies seems to be arrested for long periods at the pseudotubercle phase with slight circumscribed fibrosis.

Great damage is caused by birefringent particles which are the same size as bacteria. They are engulfed rapidly by the phagocytes. Inert carbon particles will be engulfed but do not alter the activity of the phagocytes as there is no slow leaching of the particle. Therefore they may enter the blood stream with little injury to be stored innocuously in the storage depots of the bone marrow, spleen, liver, and lymph nodes. The action of silica particles is slow, allowing activity of the phagocytes long enough for them to carry the particles to a more dangerous site, the lymphatic channel. This Trojan-horse stratagem with early blockage of the lymph system explains the progressive nature of the silicotic process. Talc, however, seems to immobilize the phagocyte without destroying it and migration from the original site is limited. Hence most of the lesions produced by talc are circumscribed granulomas, which occasionally are activated after long quiescent periods by infection or trauma. Talc in some cases gets as far as the regional lymph nodes. Since migration of phagocytes containing talc is limited, plaques of talc have been found on the peritoneum where they had been placed accidentally by contact with a glove dusted with talc. There is just enough fibrosis to surround the granuloma. This lesion tends to remain stationary for a long time. The vascular supply to the small nodule is good, as there is slight tendency for proliferation of fibrous tissue which in contraction would diminish the blood supply. Asbestos ground to particles of from 1 to 3 microns in diameter causes lesions similar to the granulomas produced by talc.

#### COMMENT AND CONCLUSIONS

Evidence is presented to show that the tissue damage caused occasionally by talc is a heavy price to pay for the preservation of a pair of rubber gloves. Granulomatous lesions of the peritoneum, draining sinuses, scar nodules, and malfunctioning intestinal stomas were found at secondary operations. Polarized light microscopy was of great value in identifying talc crystals and in studying the pathogenesis of talc granuloma. It was our impression that talc granulomas would be recognized more frequently if there were greater use of polarized light microscopy and this study substantiated this hypothesis.

Talc implanted around intentionally created fistulas in dogs caused persistence of the fistulas.

A characteristic loose fibrous tissue lesion is produced by talc in dogs, whereas tissues of human beings react by forming pseudotubercles.

Lycopodium powder has been removed from use in the operating room. Talc also must go.<sup>1</sup> Foreign bodies of this type have no place at the operating table. Lubricating oil on instruments, petrolatum, and iodoform are injurious to some individuals. Even the lint left by pressure from dry gauze sponges may be found in adhesions following multiple operations. Synthetic materials which do not leave lint behind may be available presently. In some cases these minor factors cause unnecessary postoperative discomfort.

<sup>1</sup>Following the suggestion of Seelig, Verda, and Kidd we have been using potassium bitartrate at the Mayo Clinic with satisfaction in two operating rooms for 24 months. While this substance may not preserve rubber gloves as long as talc does, gloves are usually discarded because of perforations rather than wear. It is expected that a starch that can be autoclaved soon will be available which will be superior to talc.

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### SECTION OF THE VAGUS NERVES TO THE STOMACH IN THE TREATMENT OF PEPTIC ULCER

THE important rôle of the nervous system in the production and maintenance of chronic ulcers in the stomach and duodenum has been suspected for many years. Many physicians have called attention to the high incidence of ulcers in individuals whose occupations subject them to continuous mental strain, worry and anxiety, and the tendency for exacerbations to occur during periods of emotional stress. The relatively high incidence of peptic ulcer in the armed services during the war may be, in part, due to similar causes. Direct evidence implicating the central nervous system was supplied by Cushing, who reported a greater occurrence of acute perforating ulcers of the stomach and duodenum in patients recovering from certain operations on the brain than mere coincidence could allow. These findings

have been confirmed by others and indicate a definite hazard in neurologic surgery.

How can disturbances in the brain affect the stomach and produce a progressive perforating ulcer? While the gastrointestinal tract possesses a true local automatism, its tonus, motility, blood supply, and secretory activity are greatly modified by efferent impulses in the vagi and sympathetics. To a certain limited extent, these nerves exert antagonistic effects and the end-result represents a balance of opposing mechanisms. Excessive activity of the sympathetic fibers might, on theoretical grounds, lead to spasm of the cardia, atony of the stomach, spasm of the pylorus, and decrease in the tonus and motility of the intestines. No changes in the secretion of gastric juice would be expected but generalized or local vasoconstriction might result. The idea that peptic ulcer is due to local anemia of an area of the gastric mucosa as a result of embolism or vasospasm receives continued consideration. Cushing suggested that the ulcers observed by him might have such an origin. In recent years an attempt has been made in France to treat peptic ulcer by dividing the splanchnic nerves and excising the first two lumbar sympathetic ganglia. Relief of the ulcer distress was reported but the operation seems now to have been abandoned. The relief obtained could, of course, be due to interruption of sensory fibers conveying sensations of pain from the stomach. No convincing evidence has been presented that an excessive or abnormal activity of the sympathetic nervous system exists in ulcer patients, and the experimental evidence is for the most part against this point of view.

Excessive activity or hypertonus of the vagus efferent fibers might be expected to cause a relaxation of the cardia and pylorus, an increase in the motility and tonic constriction of the stomach, and an increase in the secretion of gastric juice. Gastric hypermotility in most ulcer patients has long been recognized and of late, evidence has accumulated indicating that an excessive continuous secretion of gastric juice occurs in the empty stomach in the absence of the usual stimulus of food. Both the hypermotility and hypersecretion are abolished by complete section of the vagus nerves to the stomach indicating that they are neurogenic in origin. The characteristic ulcer distress is also relieved and that this relief is not due to interruption of sensory fibers is indicated by the fact that the distress can be produced again by the instillation of a solution of hydrochloric acid into the stomach. Objective gastroscopic and x-ray evidence of the healing of large ulcer craters in the stomach, duodenum, and perhaps most of all, in gastrojejunal stomas after vagus section provides convincing evidence that this procedure corrects those factors that maintain chronicity and progression in these lesions. Since both motility and secretion are reduced, it is not possible to decide from this evidence alone which is the more important in the pathogenesis of the disease. It is in this connection that the data from the experimental laboratory are of decisive importance and the answer is clear. Pure undiluted gastric juice can digest away the normal mucosa of the stomach, duodenum, or jejunum and produce a typical progressive ulcer. Under normal conditions the gastric juice is diluted and buffered by food and the alkaline duodenal secretions. When an excessive secretion of gastric juice occurs in the empty stomach, the buffering effect of food is absent and the neutralizing capacity

of the duodenal secretions is overcome. The gastric content then approaches pure gastric juice in free acidity and pepsin concentration and that area of the gastric or duodenal mucosa which is most exposed or least resistant first succumbs. An ulcer forms, progresses, and persists so long as exposure to relatively pure gastric juice continues. Therapy accordingly should be directed toward reducing the volume and acidity of the night secretion. The finding that the excessive continuous secretion in the fasting stomach of ulcer patients is neurogenic in origin constitutes the physiological basis for vagus section as a method of treatment. At the present writing, 90 patients have been operated upon by this method in this clinic. Keith Grimson at Duke University, Francis Moore in Boston and Dixon and Clagett at the Mayo Clinic have also reported similar series. So far, there appears to be general agreement concerning the immediate and long continued relief of ulcer distress. For the most part, the period of observation has been too short to permit a final evaluation of the method and the question of ultimate regeneration of the divided vagi remains undecided. The first 12 patients operated upon here a little over three years ago are still well, take no medication, and are under no dietary restrictions. The night secretion of gastric juice is still within the normal range and tests of gastric secretion by the sham meal and insulin hypoglycemia show that regeneration of secretory fibers in the vagi has not yet occurred.

These findings provide strong support to the concept of ulcer as a psychosomatic disease, this term being used merely to indicate that emotions and mental activity of certain types play a dominant rôle in the pathogenesis. The central nervous system disturbance causes ulcers by producing a hypertonus in the secretory and motor fibers

in the vagus nerves. While the severing of these nerves prevents nervous tensions of various kinds from affecting the stomach, it cannot be considered the final answer to the ulcer problem. Perhaps this may lie in adjusting the individual to his work and environment so that these tensions do not arise. The possibilities of psychotherapy in ulcer ought to be re-explored, and the volume and acidity of the continuous night secretion of gastric juice used as an objective quantitative measure of the effect of the treatment. Such data would probably be more impressive to the surgeon than the most subtle manipulation of a terminology he never fully understands.

LESTER R. DRAGSTEDT.

## BENIGN STRICTURES OF THE BILE DUCT

**S**TRICTURE of the common or hepatic bile duct most often follows clamping, ligation or excision of the duct during cholecystectomy. Sir James Walton has said "Every removal of a gall bladder, easy though it may seem, is fraught with very great danger, and one small error may convert a patient with a mild disability into one in immediate danger of death or of prolonged misery, and many operations, which at best may only give an incomplete life." The common duct will not be injured if it is clearly seen. The first necessity is adequate exposure with accurate definition of the junction of the hepatic, cystic, and common ducts before anything is clamped or cut. If this rule is followed, most of the hazards are eliminated. Injury occurs with inadequate exposure, inflammation or impaction of stones that shorten the cystic duct, strong traction on the gall bladder that tents up the common duct, anatomic abnormalities that confuse the relations, and blind efforts to control bleeding.

If the surgeon discovers a damaged or severed common bile duct, it should be repaired immediately for it is never easier to do later. The two ends of a divided duct should be united by end-to-end anastomosis. If a T-tube is used, the vertical limb should not come out through the suture line but rather above or below it. A duct that has been crushed by a clamp should be allowed to heal over a tube. If it is badly macerated, the devitalized tissue may be excised and an end-to-end anastomosis done.

The end-result of unrepaired common duct injury is biliary fistula or stricture with its devastating sequelæ. Small strictures are not so serious for they may often be successfully treated by plastic repair or by excision and end-to-end anastomosis. The real problem concerns those who have extensive stricture or loss of the duct, often complicated by repeated, fruitless attempts at repair and usually associated with anemia, hypoproteinemia, infection, and liver damage. These may tax the fortitude, patience and ingenuity of those who seek to repair them. No single method is applicable to all cases. In general, two methods of attack have been used; either anastomosis of the duct to the intestine or reconstruction of the duct. Of the former, anastomosis of the duct to the duodenum has been used most frequently but only 23 per cent have a successful end-result (Eliot). The Roux Y type of choledochojejunostomy, popularized by Whipple, is a more physiological intestinal anastomosis since the antiperistaltic loop of jejunum prevents reflux of intestinal contents into the biliary tract.

It appears desirable, whenever possible, to restore the normal anatomical arrangement of the part for few surgical procedures improve on nature. For this reason, even with extensive loss or stricture, efforts should be made to reunite what remains of the duct. Such a

union may be possible only with tension on the suture line which permits reformation of the stricture. To prevent stricture the duct should heal over a tube which holds it open during repair. Dissatisfaction with the tissue irritation and fibrosis caused by rubber led to the use of vitallium for this purpose. Vitallium was selected because of its lack of tissue reaction, its smooth surface which did not attract concretions and its high tensile strength which permitted a thin wall with maximum lumen. Tantalum also has these characteristics and is more malleable but it cannot be welded, so no anchoring flange can be attached to it. Plastics were discarded because most of them are tissue irritants. Vitallium tubes have the disadvantage of being so hard that they cannot be altered, at the time of operation, to meet the needs of every situation nor is it possible for them to be removed except by an operative procedure.

Recently, 226 cases of the use of vitallium tubes were collected from a group of surgeons and the results studied. The outcome was satisfactory in 80 per cent of the cases when

the tube was used for the reconstruction of the duct. Plugging of the tube occurred in 11 per cent and was the commonest cause of failure. This plugging may be diminished by using bile salts postoperatively but metabolic changes and infection make it difficult to eliminate occlusion of the tube completely. Anastomosis of the duct to the duodenum over a vitallium tube gave 58 per cent satisfactory results. The tube passed into the intestine in 38 per cent of the cases. This sequela is to be expected for no amount of anchoring will prevent the loosening of the tube. The results of Whipple's Roux Y anastomosis are still better for it is a more physiological operation.

The results enumerated are a real improvement over past experience. They are not perfect and one may question if perfection can be attained under the difficult circumstances encountered in these cases. The most profitable direction for efforts in the future would be the training of surgeons to avoid injury to the bile ducts. Until this is realized the search must continue for improvement in our present techniques and methods.

HERMAN PEARSE

# THE SURGEON'S LIBRARY

## REVIEWS OF NEW BOOKS

NO one who is interested in the surgery of the upper extremity will fail to secure stimulating and helpful ideas from a careful reading of Dr. Steindler's *Traumatic Deformities and Disabilities of the Upper Extremity*.<sup>1</sup> In this volume of almost 500 pages after a general discussion of traumatic disabilities of the upper extremity the author considers in turn disabilities of the shoulder girdle and arm (140 pages), of the elbow joint (90 pages), of the forearm and wrist (100 pages), and of the hand and fingers (75 pages).

One's first impression is of the serious and thoughtful consideration the author brings to bear on the various problems he discusses. For example (page 4), "An identical fracture of the radius may result in one case in a skeletal disalignment without any secondary impairment of the soft structures, in another case there may be no skeletal disalignment but a great deal of involvement of the soft tissues; in a third case a traumatic arthritis will develop, and in a fourth case Sudeck's atrophy on angioneurotic basis may be the principal factor of the disability." It is easy to recognize the obvious factors involved in a given problem. Steindler constantly emphasizes the importance of searching for and recognizing all the pathological factors involved if one is to solve the problem successfully.

The second impression is of the frank and objective manner in which the author attempts to evaluate the results he has obtained from the various procedures he has carried out. One must feel a very real respect and admiration for workers who attempt to evaluate the final results of the methods they have utilized, and who state them honestly. It is easier to portray only the good results and omit the failures and the reasons for their occurrence.

The section on the shoulder girdle and arm is the longest and most complete. After emphasizing the vulnerability of the shoulder girdle because of its connection to the thorax almost solely by muscle masses the author discusses in turn the acromioclavicular articulation and its dislocation, the sternoclavicular articulation and the shoulder joint and its dislocations. The various procedures advocated for the correction of recurrent dislocation are carefully described and the indications for each pointed out. The Nicola operation and the Henderson operation have proved most successful and have been used in the majority of cases.

Fractures of the clavicle followed by nonunion, fractures of the scapula, of the upper end of the

humerus—neck and tuberosities, traumatic arthritis of the shoulder joint, and fractures of the humeral shaft are discussed with unusual completeness. In reading the illustrative case reports one is constantly impressed with the variety and extent of the author's experience, and particularly with the complicated and difficult cases of bone injury—of scapula, humerus, elbow, and forearm—that have come under his care.

Consideration of injuries of the musculospiral nerve, axillary nerve, and of the brachial plexus associated with fractures and dislocations of the humerus, rupture of supraspinatus and biceps tendons, and contractures due to burns completes the section which is devoted to conditions of the shoulder girdle and arm.

Traumatic disabilities of the elbow joint, of the forearm and wrist and of the hand and fingers are taken up in turn with somewhat diminishing emphasis. The complications resulting from fractures and dislocations about the elbow joint, flexion and extension block, nerve injuries and Volkmann's ischemic contracture are discussed in helpful detail. Here again one is impressed with the difficulty and complexity of many of the cases presented, and the conservative attitude which characterizes the author's approach to their treatment. In the treatment of Volkmann's contracture the best results have been obtained by conservative treatment, and, in cases of severe deformity, when conservative treatment has failed, by resection of a part of the carpus and shortening of the extensor tendons. The author believes that there are few indications for detaching the flexor tendons from the medial epicondyle or for shortening of the bones of the forearm.

Nonunion following fracture of both bones of the forearm, radioulnar synostosis, fracture of the ulna with dislocation of the head of the radius, complicated fractures of the lower end of the radius, fractures of the scaphoid, dislocation of the semilunar, Kienbock's disease and Sudeck's atrophy, tendon transference in cases of irreparable musculospiral injury—are all considered in turn, and the treatment illustrated with case reports, diagrams and x-ray films. One can think of none of the many conditions arising from injury of forearm and wrist which has been omitted from consideration.

In the disabilities affecting the hand the chief emphasis has been placed on fractures and dislocations of metacarpals and phalanges and on tendon and nerve injuries. The author's operation and Bunell's operation for thenar palsy are carefully described and illustrated. Certain procedures concerning which the surgeon with limited experience might

<sup>1</sup>THE TRAUMATIC DEFORMITIES AND DISABILITIES OF THE UPPER EXTREMITY. By Arthur Steindler, M.D., F.A.C.S. In collaboration with John Louis Marxer, M.D. Springfield, Ill.: Charles C Thomas, 1946.



well be in doubt, for example, cup arthroplasty at an interphalangeal joint, and artificial methods for reforming tendon sheaths, are described, but the reader is left in doubt as to the author's opinion as to their value and usefulness.

Throughout the entire volume diagrams, photographs, and reproductions of x-ray films help to illustrate the text. The drawings are not always easy to interpret, sometimes they are almost "impressionistic" (Figs. 386, 387). In some instances the addition of legends would help to avoid confusion in their interpretation.

It is obvious that in reviewing a volume which touches upon so many conditions and covers such a wide field one can do little more than point out its purpose and scope. It deserves high praise, and constitutes a record of achievement that will serve both as an example and a highly useful guide to every surgeon confronted with similar problems.

SUMNER I. KOCH

THE volume entitled *Medical Services by Government* by Dr. Bernhard J. Stern, comprising 228 pages, is published by The Commonwealth Fund and is one of the studies of the New York Academy of Medicine Committee on Medicine and the Changing Order. It presents in historical perspective a comprehensive summary of the complex and expanding field of government medical services, federal, state, and local. It should be of interest to those who like to discuss the subject of state medicine which is such a popular pastime at medical meetings nowadays because it contains a great wealth of factual material bearing on this subject. From this book one gets the impression that the establishment of the doctrine of government responsibility for medical care is a *fait accompli*; that all that is left is a matter of methods and mechanics of organization. C. T. OLSON

*MEDICAL SERVICES BY GOVERNMENT: LOCAL, STATE AND FEDERAL*  
By Bernhard J. Stern, Ph.D. New York: The Commonwealth Fund, 1945.

## BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

**DIAGNOSTIC EXAMINATION OF THE EYE.** By Conrad Berens, M.D., F.A.C.S., and Joshua Zuckerman, M.D., C.M., F.A.C.S. Philadelphia, London, Montreal: J. B. Lippincott Co., 1946.

**PROCEEDINGS CONFERENCE ON DIAGNOSIS IN STERILITY.** Sponsored by the National Committee on Maternal Health, January 26-27, 1945, New York City. Edited by Earl T. Enge. Springfield: Charles C. Thomas, 1946.

**CIENCIA ESTÉTICA.** By Dr. Ramon Palacio Posse. Buenos Aires: Librería y Editorial "El Ateneo," 1945.

**FISTULAS ANORRECTALES: FISTULOTOMÍA SIN SECCIÓN DE ESFÍNTERES.** By Juan Antonio Garat. Buenos Aires: Librería Vazquez Editorial, 1946.

**SEMIOLÓGICA OBSTETRICAL.** By Juan Leon. Buenos Aires: Librería Científica y Literaria "El Ateneo," 1946.

**LESÕES DO RECORRENTE.** By Mariano A. De Andrade. Rio de Janeiro: Rodrigues & C., 1945.

**PHYSICAL EXAMINATIONS OF SELECTIVE SERVICE REGISTRANTS.** An Analysis of Reports for the Continental United States and Each State, April 1942-December 1943. Washington, D.C.: National Headquarters Selective Service System, November 1, 1944.

**LEHRBUCH DER GYNÄKOLOGIE.** Prof. Dr. Hans Guggenberger. Basel: S. Karger, 1946.

**THE NORMAL ENCEPHALOGRAM.** By Leo M. Davidoff, M.D., and Cornelius G. Dyke, M.D. 2nd rev. ed. Philadelphia: Lea & Febiger, 1946.

**SEX, MARRIAGE AND FAMILY.** By Thurman B. Rice, A.M., M.D. Philadelphia and New York: J. B. Lippincott Co., 1946.

**THE PRINCIPLES OF NEUROLOGICAL SURGERY.** By Loyal Davis, M.S., M.D., Ph.D., D.Sc., (Hon.). 3rd rev. ed. Philadelphia: Lea & Febiger, 1946.

**ILLUSTRATIONS OF REGIONAL ANATOMY.** By E. B. Jamieson, M.D. Section 1—Central Nervous System. Section 2—Head and Neck. Section 3—Abdomen. Section 4—Pelvis. Section 5—Thorax. Section 6—Upper Limb. Section 7—Lower Limb. 6th ed. Edinburgh: L. & S. Livingstone, 1946.

# CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

W. EDWARD GALLIE, TORONTO, *President*

IRVIN ABELL, LOUISVILLE, *President-Elect*

*Committee on Arrangements*

THOMAS E. JONES, *Chairman*; JOHN W. HOLLOWAY, *Secretary*

## PRELIMINARY PROGRAM FOR THE 1946 CLINICAL CONGRESS IN CLEVELAND—DECEMBER 16 TO 20

UNDER the direction of the Board of Regents, plans are proceeding for the thirty-second annual Clinical Congress, to be held in Cleveland, December 16 to 20, with headquarters at the Cleveland Public Auditorium and at the Statler and Cleveland hotels. The Auditorium is an impressive, well designed building. Its Arena, Music Hall, Little Theater, Ballroom, and other large halls, provide exceptional facilities, so that most of the activities of the Congress, except the clinical program, will be housed in it.

The program of the Congress in general will be focused upon the many medical and surgical problems connected with important postwar advances, including rehabilitation of veterans.

### CLINICAL PROGRAM

The surgeons of Cleveland have appointed an executive committee, with Dr. Thomas E. Jones as chairman, and Dr. John W. Holloway as secretary. The committee with the aid of a representative in each hospital is now preparing a preliminary clinical program. This will consist of operative and nonoperative clinics and demonstrations that will provide a comprehensive showing of their clinical activities in all departments of surgery at Western Reserve University School of Medicine and the approved hospitals of Cleveland. Under the leadership of this committee, a varied program of interest to general surgeons and all surgical specialists is assured for the 1946 Congress.

### GENERAL ASSEMBLY

The Clinical Congress will open with a general assembly in the Music Hall of the Cleveland

### EXECUTIVE COMMITTEE

THOMAS E. JONES <i>Chairman</i>	SAMUEL O. FREELANDER
JOHN W. HOLLOWAY <i>Secretary</i>	C. LEE GRABER
ARTHUR H. BILL	JOHN E. HANNIBAL
ABRAM B. BRUNER	CARL H. LENHART
JOHN F. CORRIGAN	OLIVER A. WEBER
CLARENCE W. ENGLER	THEODORE A. WILLIS

### HOSPITALS AND REPRESENTATIVES

City Hospital	JOHN HENRY LAZZARI
Cleveland Clinic	ROBERT S. DINSMORE
Evangelical Deaconess	OLIVER A. WEBER
Fairview Park Hospital	W. E. SMITH
Glenville Hospital	JACOB E. TUCKERMAN
Grace Hospital	L. J. STERNICKI
Huron Road Hospital	HENRY W. BROWN
Lakeside Hospital	FREDERICK R. MAUTZ
Lakewood Hospital	C. LEE GRABER
Lutheran Hospital	FRANK S. GIBSON
Maternity Hospital	DONALD FAULKNER
Mt. Sinai Hospital	RUDOLPH REICH
Polyclinic Hospital	HENRY SCHLINK
St. Alexis Hospital	JOHN F. CORRIGAN
St. Ann's Hospital	E. P. MONAGHAN
St. John's Hospital	FARRELL T. GALLAGHER
St. Luke's Hospital	DONALD GLOVER
St. Vincent's Charity	OLIVER A. WEBER
U. S. Marine Hospital	MARK E. MEYERS
Woman's Hospital	ERNEST COX
Veterans Hospital	DR. PARTINGTON <i>Chief Surgeon</i>

Public Auditorium at 10:00 o'clock on Monday morning. Dr. W. Edward Gallie, President of the College, will preside at this meeting which will be the opening session of the twenty-fifth annual Hospital Standardization Conference. Doctor Gallie will discuss the Hospital Standardization program of the College, especially as it affects the hospitals of Canada. Dr. Irvin Abell, Chairman of the Board of Regents, will then report on the progress of the 1946 Hospital Standardization

survey, final results of which, including the Approved Lists of hospitals, cancer clinics, and approved hospitals for graduate training in surgery, will be announced at the end of the year.

The remainder of the Monday morning session will be devoted to talks by medical and hospital authorities on advances in medicine and surgery as they affect the postwar hospital, with particular consideration of their relation to the Hospital Standardization program.

#### PRESIDENTIAL MEETING

The Presidential Meeting will be held on Monday evening in the Music Hall of the Auditorium. The officers, regents, and honorary guests will participate in the processional. Dr. W. Edward Gallie, President of the College, will preside. The address of welcome will be given by Dr. Thomas E. Jones, Chairman of the Executive Committee, foreign guests will be introduced, and Doctor Gallie will deliver the Presidential Address. An inaugural ceremony will be held for the incoming officers: President, Dr. Irvin Abell of Louisville; First Vice-President, Dr. Leland S. McKittrick of Boston; Second Vice-President, Dr. F. Phinizy Calhoun of Atlanta.

The first Martin Memorial Lecture will be a feature of the Presidential Meeting this year. Dr. Edward D. Churchill of Boston has accepted the invitation to give this lecture. The lectureship was established upon motion of the Board of Regents at its midyear meeting on April 1, as a memorial to both Dr. Franklin H. Martin and Mrs. Martin. The founder of the College and of SURGERY, GYNECOLOGY AND OBSTETRICS, was joined by his wife in making the College the beneficiary at their deaths of the Journal, together with its physical plant operated by the Surgical Publishing Company of Chicago, of which they were the owners. Doctor Martin died in 1935 and Mrs. Martin in 1945.

The Martin Memorial Lecture, to be given annually during the Clinical Congress, and dealing with a scientific subject of the author's choosing, supplants the Annual Oration in Surgery.

#### CONVOCATION

The Convocation will be held on Friday evening. It will open with a processional of officers, regents, governors, and initiates. The President, Dr. Irvin Abell, will preside, confer the honorary fellowships, and present the candidates for fellowship.

An Assembly of Initiates will be held at 10:30 on Friday morning in order to instruct them in the Convocation procedure and other matters.

On this occasion the initiates will sign the fellowship roll.

Several hundred surgeons who have been received into fellowship *in absentia* during the war years in which no Convocation was held, will be added to the number of initiates for the current year who will be present to participate in the initiation ceremonies. The Convocation and in fact the meetings throughout the Congress will be occasions for reunion with many Fellows who have recently returned from service with the military forces.

#### SCIENTIFIC SESSIONS

##### General Surgery

Eminent surgeons and specialists, recognized as authorities in their fields, will address the scientific sessions, to be held on Tuesday, Wednesday, and Thursday evenings. These will be conducted as symposia, and the subjects for the three nights will be as follows: Tuesday, "Care of the Patient Before and After Operation"; Wednesday, "Venous Thrombosis and Prevention of Pulmonary Embolism"; and Thursday, "Antibiotic and Chemotherapeutic Agents in Surgery." The annual Fracture Oration will be included in the Wednesday evening program.

Two major panel discussions will be held every afternoon except Thursday when the first panel will be omitted because of the annual meeting of the Fellows.

A symposium on fractures and other traumas will be held on Tuesday afternoon, and a symposium on cancer on Wednesday.

Concurrent panel discussions are also planned on Friday afternoon for each of the following specialties: plastic surgery, thoracic surgery, urology, neurological surgery, orthopedics, and obstetrics. Outlines of the programs are published in succeeding pages.

##### Ophthalmology and Otorhinolaryngology

Ophthalmology panel discussions will be held Tuesday, Wednesday, and Thursday mornings at 11:00 o'clock on, respectively, "Retinal Detachment," "Glaucoma," and "Keratoplasty." On Tuesday evening at 8:00 o'clock there will be a symposium on "Orbital Reconstruction Including Prosthesis." On Thursday evening a symposium is planned on "Recent Advances in Ophthalmology," with presentation of the following subjects: "Surgical Applied Anatomy in Eye Surgery," "Visual Field Defects Due to Head Injuries," "The Management of Non-Magnetic Intraocular Foreign Bodies"; and "The Treatment of Strabismus in Children."

Otorhinolaryngology panel discussions will be held Tuesday, Wednesday, and Thursday mornings at 11:00 o'clock on, respectively, "Treatment of Meniere's Disease," "Osteomyelitis of the Skull," and "Rehabilitation of the War Deafened." On Tuesday evening at 8:00 o'clock there will be a symposium on "Treatment of Deafness" and on Thursday evening a symposium on "Surgery of the Nasal Accessory Sinuses."

Of interest to ophthalmologists, otorhinolaryngologists, and other surgeons will be a symposium to be held on Wednesday evening at 8:00 o'clock on "Plastic Surgery of the Head and Neck."

#### FORUMS ON FUNDAMENTAL SURGICAL PROBLEMS

The Forums on Fundamental Surgical Problems will be conducted on Tuesday, Wednesday, Thursday, and Friday mornings. Included in them will be brief reports of original clinical and experimental observations relating to the broad aspects of surgery and the surgical specialties. No prepared discussions of the reports are planned, but questions and comments will be invited. Especially keen interest is expected in these sessions this year because of the accumulation of the results of 5 years of work since the last Clinical Congress. Dr. Owen H. Wangenstein of Minneapolis, chairman of the committee which is planning the program, is working toward representation of as many as possible of the various university departments of surgery in this presentation of clinical and experimental research work.

The enlistment of the interest of young men who are doing original work, through the forums, is one of the most beneficial results of these sessions which are now considered to be an indispensable feature of every Clinical Congress.

#### HOSPITAL CONFERENCE

The opening General Assembly on Monday morning in which both surgeons and hospital representatives will participate has been mentioned previously. The afternoon conference on Monday will be concentrated upon current problems and the outlook for the future in nursing service.

The Tuesday morning conference will be centered upon discussion of management techniques as they affect standards of hospital service. The Tuesday afternoon session will consist of a panel discussion of training and other personnel problems in specific fields, such as dietary, laboratory, x-ray, pharmacy, physical and occupational therapy, medical records, medical social service, and employe relations in small hospitals.

The Wednesday morning conference will have

as its main theme the importance of assuring high standards of care to the community and patients through providing in the general hospital facilities for all types of illness. The subject will be discussed from the standpoint of psychiatric, tuberculous, cancer, chronically ill, and convalescent patients. The Wednesday afternoon meeting will be a panel discussion on the responsibility of the administrative staff in dealing with common emergency procedures.

The Thursday morning conference will revolve around the physical plant of the hospital and the importance of improvement and modernization in raising standards of care of the patient. New mechanical and technical developments will be presented. The afternoon conference will discuss the hospital as the health center of the community, with consideration of the effects of this concept upon hospital public relations and upon the progress of preventive medicine and public health.

An evening conference will be held at 7:30 o'clock on Tuesday. This will be devoted to discussion of the responsibilities of trustees, and members of governing boards will be especially invited to attend and to participate. A conference will be held on Wednesday evening also. This will be a round table conference on responsibilities of hospital administrators, and the preparation which is necessary to enable them to cope successfully with the wide range of administrative problems. The discussion of these problems will interest all hospital personnel.

#### ANNUAL MEETING OF FELLOWS

The annual meeting of the Governors and Fellows will be held on Thursday afternoon at 1:45. There will be election of officers and governors. The annual meeting affords the Fellows of the College an opportunity to hear reports of officials on the work of the organization, and to learn how it has not only raised the professional and ethical standards of surgery, but has also promoted good hospitalization and general improvement in the practice of medicine in the United States and Canada. Each Fellow has a personal part in this work and may extend the influence of the College materially in his local community. Hospital Standardization alone offers him unlimited opportunity to provide better medical care for his patients in the hospital in which he works through continuous progress in applying the principles of the Standard which insure the best care of the patient.

Every Fellow will want to attend this important meeting, at which reports will be presented on financial affairs; Hospital Standardization; Graduate Training in Surgery; Medical Motion Pic-

tures; Publications; Public Relations; Library and Literary Research; the work of the state and provincial credentials committees, committees on applicants, and the Committee on History Reviews; Sectional Meetings, 1946; and the Department of Clinical Research, including cancer clinics, Medical Service in Industry, the Committee on Cancer, and the Committee on Fractures and other Traumas. Dr. Abell will report on administration of the College, staff changes, and retirements, and Dr. Arthur W. Allen, Vice-Chairman of the Board of Regents will discuss "Fellowships, Obligations and Opportunities."

#### STATE AND PROVINCIAL EXECUTIVE, CREDENTIALS AND JUDICIARY COMMITTEES

On Wednesday morning from 9:00 to 12:00 o'clock the State and Provincial Executive, Credentials, and Judiciary committees will meet to discuss their respective activities.

#### MEDICAL MOTION PICTURES

The latest available films showing surgical procedures and related subjects will be shown in the medical motion picture exhibits which will be held daily in the Little Theatre. These are a much appreciated feature of the Clinical Congress. Despite the decrease in production of such films during the war period, a surprising number of new pictures on varied subjects are being received by the American College of Surgeons for review.

Both sound and silent, standard and color films will be shown, all of which have been approved by the Committee on Medical Motion Pictures.

#### TECHNICAL AND SCIENTIFIC EXHIBITION

The technical exhibit, together with the registration and clinic ticket bureaus, will be held in the Cleveland Public Auditorium. Leading manufacturers of surgical instruments, x-ray apparatus, sterilizers, operating room lights, ligatures, dressings, hospital apparatus and supplies of all kinds, pharmaceuticals, and publishers of medical books will be represented in the exhibition. The technical exhibits will demonstrate many of the newer features learned from our experience in the war. Surgeons and hospital people will have opportunities to inspect the latest products of industries which help to improve their service.

#### ADVANCE REGISTRATION

The hospitals of Cleveland afford accommodations for a considerable number of visiting surgeons. However, in order to insure against overcrowding, attendance at the Congress will be limited to the number that can be comfortably accommodated at the meetings and also by accommodations in the hotels. It is therefore expected that surgeons who wish to attend the Congress will register in advance.

Fellows of the College whose dues are paid to December 31, 1945, initiates of the classes of 1942, through 1946, and Fellows in military service will not be required to pay a registration fee for the Clinical Congress in Cleveland. Checks that have already been sent for the New York Congress are being returned. For endorsed junior candidates the fee is \$5.00. Surgeons, not Fellows, who attend as invited guests of the College, will pay a registration fee of \$10.00.

#### CLEVELAND HOTELS AND THEIR RATES

Although the hotel situation in Cleveland seems more favorable than in many other cities, it is nevertheless essential to make reservations as far in advance as possible. Following is a list of the principal hotels:

	No. of Rooms	Rates
The Alcazar, Surrey and Derbyshire Roads	200	\$3.00 up
Hotel Allerton, E. 13th St. & Chester Ave.	600	2.65 up
Hotel Auditorium, E. 6th & St. Clair Ave.	300	2.00 up
Belmont Hotel, Euclid Ave. at E. 40th St.	200	2.00 up
Hotel Bolton Square, Carnegie at E. 89th St.	300	2.50 up
Carter Hotel, 1012 Prospect Ave.	600	4.00 up
Hotel Cleveland, Public Sq. & Superior Ave.	1,000	3.00 up
Fenway Hall Hotel, Euclid Ave. at Univ. Circle	400	3.00 up
The Hollenden, Superior Ave. at E. 6th St.	1,000	3.00 up
Lake Shore Hotel, 12506 Edgewater Dr.	450	3.50 up
New Amsterdam Hotel, Euclid Ave. at E. 22nd St.	300	2.00 up
Hotel Olmsted, E. 9th St. & Superior Ave.	250	3.00 up
Park Lane Villa, E. 105th & Park Lane Ave.	400	3.00 up
Sovereign Hotel, 1575 E. Blvd.	300	2.50 up
Hotel Statler, Euclid Ave. at E. 12th St.	1,000	3.00 up
Tudor Arms Hotel, Carnegie at E. 107th St.	200	3.50 up
Wade Park Manor, E. 107th & Park Lane	400	3.50 up
The Westlake, Blount St., Rocky River	400	3.00 up

## CLINICAL CONGRESS PROGRAM IN BRIEF

UNLESS OTHERWISE DESIGNATED, THE MEETING ROOMS LISTED ARE IN THE CLEVELAND AUDITORIUM

## Monday

- 10:00 General Assembly for Surgeons and Hospital Representatives, Music Hall  
 1:30-3:00 Panel Discussion, Music Hall  
 2:00 Clinics, Demonstrations and Clinical Group Conferences, Selected local hospitals  
 2:00 Hospital Conference, Ballroom  
 1:00 Surgical Film Exhibition (General), Little Theatre  
 3:30-5:00 Panel Discussion, Music Hall  
 8:00 Presidential Meeting, Music Hall

## Tuesday

- 9:00 Clinics, Demonstrations and Clinical Group Conferences, Selected local hospitals  
 10:00 Hospital Conference, Ballroom  
 9:30 Surgical Film Exhibition (Ophthalmology and Otorhinolaryngology), Little Theatre  
 9:30-12:00 Forum on Fundamental Surgical Problems, Music Hall  
 10:00 Surgical Film Exhibition (General), Little Theatre  
 11:00 Panel Discussions  
     Ophthalmology, South Hall A  
     Otorhinolaryngology, South Hall B  
 1:30-3:00 Panel Discussion, Music Hall  
 2:00 Clinics, Demonstrations and Clinical Group Conferences, Selected local hospitals  
 2:00 Hospital Conference, Club Room B  
 2:00 Symposium on Fractures and Other Traumas, Ballroom  
 2:00 Surgical Film Exhibition (General), Little Theatre  
 3:30-5:00 Panel Discussion, Music Hall  
 7:00 Surgical Film Exhibition (Ophthalmology and Otorhinolaryngology), Little Theatre  
 7:30 Hospital Conference—Trustees, Ballroom, Hotel Statler  
 8:00 Symposium, General Surgery, Music Hall  
 8:00 Symposium, Ophthalmology, South Hall A  
 8:00 Symposium, Otorhinolaryngology, South Hall B

## Wednesday

- 8:00 Meeting of Cancer Committee, Tavern Room, Hotel Statler  
 9:00 Clinics, Demonstrations and Clinical Group Conferences, Selected local hospitals  
 9:30 Hospital Conference, Ballroom  
 9:30 Surgical Film Exhibition (Ophthalmology and Otorhinolaryngology), Little Theatre  
 9:30-12:00 Forum on Fundamental Surgical Problems, Music Hall  
 10:00 Surgical Film Exhibition (General), Little Theatre  
     State and Provincial Committees:  
     9:30 Judiciary Committees  
     10:00 Executive Committees  
     10:30 Credentials Committees and  
     Committees on Applicants  
 11:00 Panel Discussions  
     Ophthalmology, South Hall A  
     Otorhinolaryngology, South Hall B  
 12:00 Meeting of Board of Governors, Lattice Room, Hotel Statler  
 1:30-3:00 Panel Discussion, Music Hall  
 2:00 Clinics, Demonstrations and Clinical Group Conferences, Selected local hospitals  
 2:00 Symposium on Cancer, Ballroom  
 2:00 Surgical Film Exhibition (General), Little Theatre

- 2:30 Hospital Conference, Club Room B  
 3:30-5:00 Panel Discussion, Music Hall  
 6:00 Vandyck Reunion Dinner  
 7:00 Surgical Film Exhibition (Ophthalmology and Otorhinolaryngology), Little Theatre  
 7:30 Hospital Conference—Administrative Problems, Club Room B  
 8:00 Symposium, General Surgery, Music Hall  
 8:00 Symposium, Ophthalmology and Otorhinolaryngology, South Hall A

## Thursday

- 9:00 Clinics, Demonstrations and Clinical Group Conferences, Selected local hospitals  
 9:30 Hospital Conference, Ballroom  
 9:30 Surgical Film Exhibition (Ophthalmology and Otorhinolaryngology), Little Theatre  
 9:30-12:00 Forum on Fundamental Surgical Problems, Music Hall  
 10:00 Surgical Film Exhibition (General), Little Theatre  
 11:00 Panel Discussions  
     Ophthalmology, South Hall A  
     Otorhinolaryngology, South Hall B  
 1:30 Adjourned Meeting, Governors, Music Hall  
 1:45 Annual Meeting, Fellows, Music Hall  
 2:00 Clinics, Demonstrations and Clinical Group Conferences, Selected local hospitals  
 2:00 Hospital Conference, Ballroom  
 3:00 Panel Discussion—Graduate Training in Surgery, Club Room B  
 3:30-5:00 Panel Discussion, Music Hall  
 3:30 Surgical Film Exhibition (General), Little Theatre  
 3:30 National and Regional Fracture Committees, Club Room C  
 4:00 Committee on the Library  
 7:00 Surgical Film Exhibition (Ophthalmology and Otorhinolaryngology), Little Theatre  
 8:00 Symposium, General Surgery, Music Hall  
 8:00 Symposium, Ophthalmology, South Hall A  
 8:00 Symposium, Otorhinolaryngology, South Hall B

## Friday

- 9:00 Clinics, Demonstrations and Clinical Group Conferences, Selected local hospitals  
 9:30 Surgical Film Exhibition (Ophthalmology and Otorhinolaryngology), Little Theatre  
 9:30-12:00 Forum on Fundamental Surgical Problems, Music Hall  
 10:00 Surgical Film Exhibition (General), Little Theatre  
 10:30 Assembly of Initiates, Ballroom  
 1:30-3:00 Panel Discussion, Surgery of the Stomach, Music Hall  
 2:00 Clinics, Demonstrations and Clinical Group Conferences, Selected local hospitals  
 2:00-4:00 Panel Discussions  
     Obstetrics, South Hall A  
     Plastic Surgery, Club Room  
     Neurological Surgery, Club Room  
     Thoracic Surgery, South Hall A  
     Urology, South Hall C  
     Orthopedic Surgery, Club Room  
 2:00 Surgical Film Exhibition (General), Little Theatre  
 3:30-5:00 Panel Discussion, Surgery of the Stomach, Music Hall  
 8:00 Convocation, Music Hall

## EVENING SYMPOSIA

## GENERAL SURGERY

Tuesday, 8:00 p.m.

*Care of the Patient before and after Operation*

Fluid and Electrolyte Balance. CARL MOYER, Eloise, Michigan.

Nutritional Preparation of the Substandard Risk Patient. RICHARD L. VARCO, Minneapolis.

Use of Blood and Blood Substitutes. JOHN D. STEWART, Buffalo.

Blood Transfusion Problems, with Special Reference to the Rh Factor. ALEXANDER S. WIENER, Brooklyn.

Safe Conduct of the Patient Through Operation. OWEN H. WANGENSTEEN, Minneapolis.

Wednesday, 8:00 p.m.

*Venous Thrombosis and Prevention of Pulmonary Embolism*

Interruption of Deep Veins. ARTHUR W. ALLEN, Boston.

Sympathetic Nerve Block. ALTON OCHSNER, New Orleans.

Anticoagulants. D. W. GORDON MURRAY, Toronto.

*Fracture Oration*

Modern Methods in the Treatment of Fractures EDWIN W. RYERSON, Chicago.

Thursday, 8:00 p.m.

*Antibiotic and Chemotherapeutic Agents in Surgery*

Pathologic Physiology of Surgical Infections. JOHN S. LOCKWOOD, New Haven.

Penicillin—Its Use in Surgery and Influence on Earlier Types of Chemotherapy. WILLIAM A. ALTEMEIER, Cincinnati.

Streptomycin. HORTON C. HINSHAW, Rochester.

Correlation of the Use of Antibiotic and Chemotherapeutic Agents with General Principles of Surgery. CHAMP LYONS, New Orleans.

## OPHTHALMOLOGY

Tuesday, 8:00 p.m.

*Orbital Reconstruction Including Prosthesis*

Acrylic Prosthesis. A. D. RUEDEMANN, Cleveland

Basket Implant. NORMAN L. CUTLER, Wilmington.

Reconstruction of Orbital Floor Defects. Major ARTHUR E. SHERMAN, Springfield, Missouri.

Thursday, 8:00 p.m.

*Recent Advances in Ophthalmology*

Surgical Applied Anatomy in Eye Surgery. MEYER WIENER, Coronado.

Visual Field Defects Associated with Head Injuries. JOHN S. MCGAVIC, Fort Madison

The Management of Non-Magnetic Intraocular Foreign Bodies. HARVEY E. THORPE, Pittsburgh.

The Treatment of Strabismus in Children. MAYNARD C. WHEELER, New York.

## OTORHINOLARYNGOLOGY

Tuesday, 8:00 p.m.

*Treatment of Deafness*

The Management of the Chronic Suppurating Ear. JAMES H. MAXWELL, Ann Arbor.

The Fenestration Operation. GEORGE E. SHAMBAUGH, JR., Chicago.

Use of Radium for Conductive Deafness. JOHN E. BORDLEY, Baltimore.

Thursday, 8:00 p.m.

*Surgery of the Nasal Accessory Sinuses*

Indications for Surgery in the Light of the Use of Antibiotics. HARRY P. SCHENCK, Philadelphia.

Intranasal Surgery. JOHN J. SHEA, Memphis.

External Operations.

## PLASTIC SURGERY OF THE HEAD AND NECK

*Wednesday 8 p.m.*

Cancellous Bone Grafts to the Jaw. TRUMAN G. BLOCKER, Galveston.

Repair of Nasal Defects with Free Composite Grafts of Skin and Cartilage from the Ear. JAMES B. BROWN, St. Louis.

Studies in the Anatomy and the Repair of Cleft Palate.

Preservation of Function Following Resections of Jaw Tumors. LOUIS T. BYARS, St. Louis.

## PANEL DISCUSSIONS

## GENERAL SURGERY

*Monday, 1:30-3:00 p.m.*

Rehabilitation of the Surgical Patient and Early Ambulation. Leader, HOWARD RUSK, New York.

*Monday, 3:30-5:00 p.m.*

The Treatment of Cancer of the Large Bowel. Leader, FREDERICK A. COLLIER, Ann Arbor.

*Tuesday, 1:30-3:00 p.m.*

Thiouracil in Thyroid Disease. Leader, FRANK LAHEY, Boston.

*Tuesday, 3:30-5:00 p.m.*

Recent Trends in the Management of Carcinoma of the Cervix. Leader, JOE VINCENT MEIGS, Boston.

*Wednesday, 1:30-3:00 p.m.*

Anesthesia. Leader, HENRY K. BEECHER, Boston.

*Wednesday, 3:30-5:00 p.m.*

Protein Metabolism in the Surgical Patient. Leader, ROBERT ELMAN, St. Louis.

*Thursday, 3:30-5:00 p.m.*

Spinal Cord Injuries. Leader, HOWARD C. NAFFZIGER, San Francisco.

*Friday, 1:30-3:00 p.m.*

Surgery of the Stomach. Leader, ROSCOE R. GRAHAM, Toronto.

*Friday, 3:30-5:00 p.m.*

Surgery of the Vascular System. Leader, DANIEL C. ELKIN, Atlanta, Georgia.

## SURGICAL SPECIALTIES

*Friday, 2:00-5:00 p.m.*

Orthopedic Surgery Panel. (Subject to be announced.) Leader, CARL E. BADGLEY, Ann Arbor.

Urology Panel. (Subject to be announced.) Leader, HERMAN L. KRETSCHMER, Chicago.

Plastic Surgery Panel. (Subject to be announced.) Leader, ROBERT H. IVY, Philadelphia.

Neurological Surgery Panel. (Subject to be announced.) Leader, FRANCIS C. GRANT, Philadelphia.

Obstetrics Panel. (Subject to be announced.)

Thoracic Surgery Panel. (Subject to be announced.) Leader, RICHARD H. SWEET, Boston.

## OPHTHALMOLOGY

Panel discussions in the field of Ophthalmology are planned for Tuesday, Wednesday, and Thursday mornings at 11:00 o'clock, on the following subjects: Retinal Detachment; Glaucoma; Keratoplasty.

## OTORHINOLARYNGOLOGY

Panel discussions on subjects in the field of Otorhinolaryngology are planned for Tuesday, Wednesday and Thursday mornings at 11:00 o'clock on the following subjects, respectively: The Treatment of Ménière's Disease; Osteomyelitis of the Skull; Rehabilitation of the War Deafened.



## SYMPOSIUM ON FRACTURES AND OTHER TRAUMAS

**A**T 2:00 o'clock on Tuesday afternoon there will be held a symposium on Fractures and Other Traumas under the direction of Robert H. Kennedy of New York. This symposium will be devoted to a number of brief presentations by specialists in various fields concerning new or improved methods adopted during the war which are applicable to injury in civilian surgery. The aim is to give a rapid survey of worthwhile gains made during the war which may prove of lasting value in the field of trauma.

Among the fifteen or twenty short papers which are planned are the following:

Bone Grafts. GEORGE K. CARPENTER, Nashville.  
Spinal Cord Injuries. DAVID H. POER, Atlanta.

Injuries to the Rectum. EDMUND J. CROCE, Worcester.

Transportation of Fractures. WILLIAM J. STEWART, Columbia.

Replacement of Skin Defects. JAMES B. BROWN, St. Louis.

Fractures of the Carpal Scaphoid. MATHER CLEVELAND, New York.

Amputations. RUFUS H. ALDREDGE, New Orleans.

Training of Amputees. HENRY H. KESSLER, Newark.

Rehabilitation. Col. A. WILLIAM REGGIO, Washington.

Compound Fractures Treated with Penicillin and Delayed Primary Closure. OSCAR P. HAMPTON, Jr., St. Louis

## SYMPOSIUM ON CANCER

A symposium on cancer is planned for Wednesday afternoon. The Cancer Committee of the College has done outstanding work in furthering the development of cancer clinics in hospitals and providing for the registration of cured cases of malignant disease in the cancer archives. The chairman of this com-

mittee will give a brief review of these activities of the College in opening the symposium.

Other subjects of practical interest are under consideration for inclusion in the program, which is being planned to interest surgeons, pathologists, and radiologists.

October, 1946

# **SURGERY**

## **GYNECOLOGY AND OBSTETRICS**

*Supplement*

### **INTERNATIONAL ABSTRACTS OF SURGERY**

**LOYAL DAVIS, EDITOR IN CHIEF**

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## COLLECTIVE REVIEW

### THE TREATMENT OF HYPERTHYROIDISM WITH THIOURACIL, WITH PARTICULAR REFERENCE TO TOXIC REACTIONS

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SEVERAL thousand patients with hyperthyroidism have now been treated with thiouracil, and over a thousand cases have already been reported in the current literature. Hence, it now appears possible to attempt an evaluation of the incidence, types, and severity of the associated toxic reactions. Astwood (2) reported early on the possibility of permanent cures resulting from thiouracil therapy (1). As yet, insufficient time has elapsed since the institution of this treatment to determine how often, and when, permanent cures may be expected. However, it will be of great value to know in what type of patient a permanent cure can be anticipated, particularly since, if a cure is expected, many patients would prefer even prolonged medical management with thiouracil to surgery. It seems obvious that unless the incidence of toxic reactions to thiouracil is low and the incidence of permanent cure is high, thiouracil therapy is therapeutically and economically unsound except in those patients who are poor operative risks following iodine therapy, or who refuse surgical treatment.

#### TOXICITY OF THIOURACIL

From assembled reports in the literature on the thiouracil treatment of thyrotoxicosis, it is noted that slightly over 13.77 per cent of the 1,573 reported cases have shown some type of toxic reac-

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tion. Of these toxic manifestations, 7 reported cases (an incidence of 0.57 per cent) have proved fatal. Two other fatalities due to thiouracil have been quoted by Vorhaus and Rothendler, but have not been included in this figure; and Curtis has observed another fatality. Of the nonfatal reactions, the majority were so mild or so transitory that it was found unnecessary to discontinue medication, yet in other instances it was only the frequent and close scrutiny of the attending physician which forestalled a fatal termination.

Of all the reactions reported, agranulocytosis, though not a common complication (0.78%), is by far the most important, since it has been responsible for all of the fatalities due to thiouracil which thus far have been reported. A study of these cases reveals that a majority of the patients received an initial dose of at least 1 gm. of thiouracil per day, although in most cases this dosage was later reduced. The reactions may occur at any time during therapy, thus emphasizing the necessity of keeping the patient under close scrutiny at all times. There is no way of predicting what type of patient might sustain reactions, except that the incidence of agranulocytosis is somewhat higher among patients who have had a second course of the drug after its discontinuance for a time.

*Agranulocytosis.* There appear to be two possible basic explanations for the granulocytopenia or agranulocytosis that is provoked by thiouracil. It might be explained as the result of the depres-

sion of the bone marrow upon a purely *toxic chemical basis* or upon the basis of some *allergic response* to thiouracil. The theory of suppression of the production of granulocytes on a toxic basis is lent support by the studies of Williams, Kay, and Jandorf, who were able to demonstrate that the bone marrow contains the largest proportion of the thiouracil of any body tissue or organ. These workers were also able to demonstrate that the blood cells contain about seven times as much thiouracil as the blood plasma, and that while the erythrocytes, because of their greater number, contained twice the amount present in the leucocytes, the average amount of drug per cell was much greater in the leucocytes. The fact that the majority of cases of agranulocytosis have developed in those individuals on a relatively high dosage of thiouracil, i.e., over 800 mgm. per day, also supports this view. The observation that patients on large doses of thiouracil who develop leucopenia usually recover a normal count when the dosage level is reduced, leads one to a similar conclusion. Some patients have developed agranulocytosis during uninterrupted thiouracil therapy, and this would argue against the probability that sensitization on an allergic basis was the underlying mechanism.

Against the toxic point of view, and in favor of the allergic explanation may be cited the following facts: many cases of serious granulocytopenia have been noted in persons receiving as little as 0.2 gm. of thiouracil per day. Moreover, the majority of granulocytopenic reactions have occurred in patients who have had one or more previous courses of thiouracil therapy and who might thus be said to have been sensitized to the drug. Himsworth believes that a special sensitivity to the drug is present in many persons and that in these cases the failure of ill effects to appear after the first fortnight suggests either that the sensitive subjects are few in number and are eliminated by early detection, or that desensitization is effected by continued treatment (4). The author's analysis of cases reported agrees with Himsworth's conclusion that those persons who exhibit the allergic type of response develop the more serious reactions.

The significance of the development of granulocytopenia (from causes other than thiouracil) can be fully appreciated by quoting Plum:

"The prognosis is extremely bad. Most of the fairly large collection of cases show a mortality amounting to 70 to 90 per cent. In 52 patients, the white cell count was less than 1,000; of these patients, 47 died (90 per cent). In 20 cases, the white cell count was between 1,000 and 2,000; 15 of the patients died (75 per cent). In nine patients, the white cell count was over 2,000 and five of them died (56

per cent). (It might be noted that this was in the days before some of the present day supportive forms of therapy were utilized.) In fatal cases, the disease takes a very rapid course, lasting usually about one week, but often only a few days. The subjective complaints, the overpowering weakness, sore throat, dyspnea and anxiety usually increase during the course of the illness. Though confusion is not uncommon, most of the patients remain lucid till a few hours before death. The conditions grow worse from day to day, the necrotic lesions in the mouth and throat increase and the swelling of the cervical glands gets more pronounced, often associated with coincident edema in the surrounding tissues. The temperature remains at a level of about 104. Most of the fatal cases leave no time for the appearance of complications other than pneumonia."

It should be mentioned that patients with hyperthyroidism *per se* frequently have subnormal leucocyte counts, but from the standpoint of safety during thiouracil therapy, any low counts should be considered a toxic reaction until proved otherwise. Hyperthyroidism presents a characteristic increase in the number of lymphocytes (26), which should not be confused with the relative increase produced by a depression in the production of granulocytes. Neutropenia, when it occurs, appears suddenly in patients whose previous blood counts have been normal both in respect to total white cells and total neutrophils. This observation agrees with that of Bartels and has been true likewise in our series of cases. Himsworth also suggests that the appearance of a leucopenia or neutropenia may be foreshadowed by the appearance of many young neutrophils in the peripheral blood.

Rubinstein reported one case of nonfatal agranulocytosis in a patient suffering from carcinoma of the thyroid with metastases, treated with thiouracil. A very detailed study of the *bone marrow* was made at the time therapy was discontinued and during the period of recovery, which revealed a considerable decrease in the total myeloid count and an arrest of maturation of the myeloid series. In a study of the course of recovery of the bone marrow, after discontinuance of thiouracil therapy, Rubinstein reported that the return to normal of the bone marrow changes precedes that of the peripheral blood. In serial bone marrow aspirations, he found a gradual increase of the number of myeloid cells coincident with a progressive shift to the right. At the same time the peripheral blood counts showed an ascending curve, though lagging behind the recovery of the bone marrow. The cell distribution within the myeloid series of the bone marrow and their total count reached almost normal values about 15 days after the drug was discontinued, although at this time there was still a considerable leucopenia in the peripheral blood (65).

Peripheral blood studies in agranulocytosis due to thiouracil may be summarized as follows: there is no evidence that thiouracil therapy produces a steady depression of the leucocytes in the peripheral blood; rather, neutropenia is a sudden and unexpected occurrence, though possibly the appearance of many young neutrophils in the peripheral blood may give some warning of the possible onset of leucopenia (59). The first warning of agranulocytosis is the reduction of circulating granulocytes below 50 per cent; often the granulocytes may show toxic changes (32); a relative increase of monocytes at the time of the lowest white counts is regarded by many as a favorable prognostic sign (16, 64). Rubinstein's statement that the peripheral blood during recovery lags behind the recovery of the bone marrow, and is characterized by a gradual increase in the numbers of leucocytes, has already been mentioned; Plum, in his monograph on agranulocytosis in general, states that those granulocytes which are present in the fatal cases are most often degenerated, with vacuolated cytoplasm, poorly staining granules and pyknotic nucleus. In the patients who recover or die after hematologic improvement, the granulocytes look quite different, as they are largely young cells that may be designated as premyelocytes, myelocytes, metamyelocytes, and staff nuclears. In most cases, the lymphocytes make up the greater part of the total white cells in the blood of agranulocytic patients. These cells usually look normal but sometimes they show signs of damage, the nuclei being pyknotic and the cytoplasm containing vacuoles. Some significance is to be attributed to the number of plasma cells, as the percentage may be slightly increased (59).

Though the original workers in this field often employed dosages exceeding 1 gm. of thiouracil per day, there is reason to suppose that the use of smaller doses will tend to reduce the incidence of complications (83). Palmer holds that probably 0.6 gm. of thiouracil is the optimum maximum daily dose, though good results have been obtained with an initially high saturation without complications. Palmer has been able to treat with success, in all instances, a group of 50 patients without serious complications, for a period of 1 to 10 months; however, the development of transient leucopenia in 9 cases necessitated the discontinuance of therapy for a period of 72 hours, an effect which disappeared within 48 hours and which did not reappear after treatment with thiouracil had been resumed.

Williams and Clute advocate a similar plan and level of thiouracil dosage, as a means of reducing

the incidence of toxic manifestations, and also because they feel that excessive amounts of thiouracil may increase the size of the goiter as well as accentuate the manifestations of malignant exophthalmos. These workers note also that of 152 cases treated by them, the incidence of reaction was 23 per cent in the first 52 patients to whom large doses of the drug had been given, and only 4 per cent in the last 100 patients who had received relatively small doses.

Granulocytopenia (2, 5, 15, 41) or agranulocytosis (84) may appear at any stage in the course of therapy regardless of the dosage employed, and for this reason it is of paramount importance that frequent white cell counts as well as differential counts be made, care being taken to search for the presence of toxic changes in the cells so that should any tendency toward granulocytopenia exist, it may be noted at the earliest possible moment. If the leucocyte count should drop below 4,000 thiouracil therapy should be discontinued, at least temporarily, even though no toxic changes in the cells are demonstrable; if the count does not return to normal within 48 hours, further therapy is probably dangerous.

In the treatment of agranulocytosis, Goldsmith and his coworkers report that the prophylactic administration of crude liver intramuscularly is of value in prevention of the condition induced by the administration of either sulfonamides or thiourea. Daft and Sebrell, by similar studies, (also on rats) appear to have demonstrated that folic acid is the active agent in liver that is responsible for its protective effect on the granulocytes or their precursors. Pentnucleotide (0.7 to 1.4 gm. daily, intramuscularly) may be given (Williams and Clute).

Vitamin C in 100 mgm. daily doses has been reported by Palmer to decrease the incidence of toxic manifestations. On the basis of their favorable experiences with pentnucleotide, Williams and Clute have advocated the prophylactic administration of brewer's yeast routinely to their patients in the hope of protecting them against agranulocytosis.

Pyridoxine, vitamin B<sub>6</sub>, a pyridine compound essential to animal nutrition, has been employed by Cantor and Scott in the treatment of granulocytopenia, with recovery, though here again it is difficult to rule out the possibility of a spontaneous remission.

Once the presence of agranulocytosis has been established several measures have been generally employed to prevent, if possible, the onset of secondary infections which may cause death because of the absence of granulocytes to destroy or



TABLE I.—INCIDENCE AND TYPES OF THIOURACIL REACTIONS—Continued

Investigator	Total Cases	Total Reactions	Agranulocytosis	Leucopenia	Dermatitis and Urticaria	Fever	Edema	Submaxillary Swelling	Lymphadenopathy	Arthralgia	Purpura	Pruritus	Nausea, Vomiting, or Diarrhea	Hematuria	Jaundice	Neurological Symptoms	Deaths
Neuman	34	0															
Nussey	27	4			4			1				1					
Palmer	50	8		1		1		4						3			
Pashais, et al	30	4		1	3	4				2					1		
Rawson, et al	25	0															
Raveno	32	8			4	2							5				
Rose and McConnell	37	10		2	5	3	1		1	1			1				
Rubenstein	1	1	1														
Sharpey-Shafer	30	0															
Sloan and Shorr	12	3			2										1		
Sprunt	36	5					5										
Strong and Bell	3	0															
Thompson	13	4		1	3												
Vorhaus and Rothendler	25	3				1	1				1						
Watson and Wilcox	35	3		2			1						1				
Weishman	2	2		2													
Whittlesey	1	0															
Williams and Clute	153	24	1	1	0	3	6	1		2			3				1
Wosicka and Braun	1	1	1														
	1573	215	12	40	56	41	26	11	6	11	6	12	13	4	5	5	0

localize the invading organisms before the bone marrow has an opportunity to recover. Whole blood should be administered to provide leucocytes to take over the function of the absent cells in the patient. One should also utilize the bacteriostatic and bacteriocidal effect of penicillin, given in large doses. Penicillin can certainly be given with safety since, according to Kolmer, there have thus far been no fatalities due to the administration of this antibiotic even in cases of agranulocytosis, and hence its use is warranted when indicated. However, should the bone marrow fail to recover its proliferative powers rapidly, even penicillin is powerless to prevent fatal secondary infection.

Sulfonamides have been employed (1) with the purpose of producing bacteriostasis even though many cases of granulocytopenia or agranulocytosis have been recorded as a result of sulfonamide therapy.

**Purpura.** This complication is rare; only about 6 such cases have been reported to date. In most instances this complication has been associated

with granulocytopenia, a fact which would suggest that it is another manifestation of a toxic depression of the bone marrow which has also adversely affected the megakaryocytes which are supposedly responsible for the adequate production of blood platelets. Joll has reported the development of a case of purpura after 6 months of therapy, which necessitated the discontinuance of medication, though the development of agranulocytopenia was not mentioned. Dunlop has presented a patient whose white blood count dropped to 2,000 (granulocyte count, 33 per cent) while on a dosage of 0.6 gm. of thiouracil per day. Four days after cessation of thiouracil the white cell count had returned to 4,100 and the differential count to normal. Administration of thiouracil was resumed, but a quarter of an hour after the first dose of 0.6 gm. had been given, a violent sensitivity reaction resulted. There was severe headache and pain in the muscles, vomiting, swelling of the lips, face and ankles, a rise of temperature to 101, tachycardia, and a purpuric eruption in the bend of the elbow when the blood

pressure was taken. The reaction took place at 6 p.m., the patient remaining ill during the night and recovering the next day. Recovery was complete in 24 hours. It is interesting to note that the platelet count remained normal during the reaction, whereas the white count fell to 1,880, though returned to 4,100 in 2 days. In view of the absence of a thrombocytopenia in the cases cited, it may be argued that the purpuric manifestations noted should be explained on some other basis than a deficiency in platelets. Flink and Evans have reported one case in which a definite thrombocytopenia was noted.

*Dermatitis* is the most common evidence of sensitivity to thiouracil; it occurs in about 4.5 per cent of the cases. Dermatitis is meant to include those cases in which either a rash or severe pruritus developed. Dermatitis in itself is of little significance, but the occasional association of this manifestation with other more serious reactions such as chills, fever, and occasional arthralgia and granulocytopenia, warrants careful observation of these patients. For example, Pashkis, et al (58) have reported fever, chills, and joint pain in 2 of 3 patients having a maculopapular rash.

*Pruritus*. In our series there were 7 instances of pruritus which lasted from 7 to 10 days, though without any other associated toxic manifestation; cessation of therapy was therefore unnecessary. It is probable that pruritus is a skin manifestation of an allergic response to thiouracil. It represents less than 25 per cent of all the toxic skin signs and is perhaps the least significant of all the toxic skin signs, which in turn are the least significant of all reactions.

*Urticaria* is not so common as dermatitis; it occurs in 0.4 per cent of patients treated with thiouracil (16, 63).

*Fever*. A febrile reaction is encountered in about 2.6 per cent of patients treated with thiouracil. It does not appear, however, as an isolated manifestation, since it is associated with dermatitis in 50 per cent of the cases, and with granulocytopenia in about 10 per cent of the cases. The patient frequently has a chill with the fever; usually the temperature is about 102 or 103° F., and there is often an associated headache, general malaise, and tachycardia. However, the fever rapidly disappears when thiouracil medication is discontinued. In at least 4 instances fever has been associated with jaundice (26, 36, 58). Rarely, as in Sloan and Shorr's case, jaundice may occur without fever.

The observation of Pashkis and his associates (58) in a patient with a urine urobilinogen of 1:100, a serum bilirubin of 2.5 mgm. per cent, and

a dye retention of 60 per cent, indicates that the liver damage may be the basis of the jaundice. That thiouracil may produce liver damage is further substantiated by Sloan and Shorr, and Gargill and Lesses. However, McGavack and his associates, in a series of 9 patients, were unable to demonstrate evidence of liver damage either by means of hippuric acid excretion, glucose tolerance curves, icteric index, cephalin flocculations, or Van den Bergh reactions. It is, of course, well known that on certain occasions a great deal of liver damage may be present before liver function tests will be positive.

*Edema*. Edema of the extremities or of the eyelids is a frequent complication of thiouracil therapy, and it occurs in about 16 per cent of cases. There appear to be at least two explanations for this condition. One explanation is that this edema is actually due to myxedema resulting from complete suppression of thyroxine formation by thiouracil. Dunlop and Davidson have also noted the frequent occurrence of edema during treatment, and have been able to show that this edema is unassociated with cardiac failure or signs of renal damage, and that it disappears even though treatment is continued. That myxedema is the explanation for some of these cases of edema is further borne out by the fact that edema is usually not an early complication but rather one which develops after the patient has been on therapy for a month or more.

It is probable that low blood proteins as a cause of edema may be excluded since McGavack, in 9 cases under thiouracil treatment, has observed no constant effect on the blood proteins due to treatment.

A second possible explanation of edema may be in changes in the plasma chloride level or carbon dioxide combining power. Although low blood chlorides have been reported (79), such a finding is by no means constant.

*Swelling of the salivary glands*. Painful swelling of the salivary glands and lymphadenopathy has been reported in several series as a complication of thiouracil medication. Gargill and Lesses also have reported one case of splenomegaly which they have attributed to thiouracil sensitivity. A majority of these complications have been noted to subside within a few weeks even though therapy is continued. Presumably these reactions are manifestations of a general hypersensitivity to thiouracil, displayed by the reticuloendothelial system. It is likely that the pathological basis for the glandular swelling, as in the case of lymphadenopathy produced by other medication (72), is an acute edema of the glandular or lymphoid

structure, with an associated hyperplasia of the germinal centers in the latter instance, due to thiouracil stimulation.

*Arthralgia.* Painful joints represent a fairly common complication; the condition occurs in about 0.70 per cent of patients treated with thiouracil. However, it must be borne in mind, as McCullough and his associates have emphasized, that peri-arthritis is a common complaint in hyperthyroidism. It is not unusual to find arthralgia accompanied by fever and chills, or a rash. The arthritic manifestations mentioned are not unimportant since, as Williams has stated, "except for fever, arthritis and leucopenia, the complications (of thiouracil medication) have been observed to disappear with only a reduction in the size of the dose (78)." However, many of the cases of arthritis do tend to disappear without a reduction in the level of dosage.

*Nausea and vomiting.* These complaints with an occasional diarrhea have been reported in about 0.84 per cent of patients treated. In Raveno's patients complaining of this complication, symptoms did not develop until the second or third week of therapy. Overdosage may be a cause of nausea and vomiting, but the average daily dose in Raveno's cases was only 0.6 gm. Because of absence of the more severe forms of reaction in association with these gastrointestinal symptoms, it has rarely been found necessary to discontinue medication, although at times a reduction in the dosage level has been made with prompt subsidence of the undesired symptoms.

*Miscellaneous complications.* To complete the list of untoward symptoms which are rarely encountered, one must add those of hematuria and crystalluria, central nervous system irritation, and anemia. The occurrence of a mild form of pharyngitis (26) and conjunctivitis (37) have also been claimed by some to be a toxic sign though an insignificant one. Palmer, in a series of 50 patients treated with 0.6 gm. of thiouracil daily, observed hematuria and crystalluria in three instances. Palmer has advocated the administration of alkalinizing substances in conjunction with thiouracil, and the adequate administration of fluids. Under this regimen, she was able to continue thiouracil medication which was followed by the disappearance of hematuria and crystalluria.

Recently, Haines and Keating have reported what they believe to be evidence that thiouracil may produce toxic disturbances in the central nervous system. In 2 cases these workers have observed myoclonic contractions of various muscles, particularly the facial muscles, in pa-

tients receiving thiouracil treatment. These contractions were definite and persistent, and did not disappear until several days after thiouracil had been discontinued. That this reaction was actually due to thiouracil is confirmed by the fact that similar evidences of central nervous system irritability reappeared upon two subsequent attempts to readminister the drug. It should be mentioned also that somnolence and mental confusion were evident as a result of the attempt to readminister thiouracil, hence further thiouracil treatment was discontinued. In one instance in our series, a patient complained of numbness and tightness of the fingers for several weeks while under thiouracil therapy, though in the absence of other subjective or objective findings.

#### REMISSIONS OR CURES

When originally introduced in the treatment of hyperthyroidism, thiouracil was used mainly in the preparation of patients for surgery. However, the success of thiouracil in producing and maintaining a low level of thyroid activity on low maintenance doses, i.e., 100 to 200 mgm. daily, provoked the hope that hyperthyroidism might be abolished by purely medical means (2). Dunlop has stated that the basis for this hope is the fact that long continued hyperplasia may ultimately give way to atrophy of the thyroid gland and that if the patient can be tided over until this occurs, the state of thyrotoxicosis may be cured. Eaton has recorded remissions of 8 months' duration in 4 patients and of 3½ months in an additional 3 patients. Astwood (3) summarized his experience with sustained remissions by noting that when thiouracil therapy was maintained for 6 to 9 months, prolonged remissions resulted; of 11 such patients observed for longer than 3 months, 10 have had no evidence of recurrent hyperthyroidism. All workers have observed that a second course of thiouracil is just as effective as the first when given to patients whose symptoms have recurred after cessation of therapy.

In our experience with patients treated at Illinois Research Hospital, only those patients who are mildly toxic may be expected to obtain prolonged remission following discontinuation of medication, even though the drug has been given over a period of 6 to 9 months. The accompanying table demonstrates that our patients, whose basal metabolic rate was below plus 40 per cent prior to thiouracil therapy, have remained free of symptoms of hyperthyroidism for an appreciable period, whereas those patients whose basal metabolic rate was higher have in all instances suffered a relapse.



TABLE II.—THE RELATIONSHIP OF THYROID TOXICITY TO DURATION OF REMISSION FOLLOWING CESSATION OF THIOURACIL THERAPY (PERSONAL EXPERIENCE)

Case No	Original B M R.	Months Treated	Recurrence	Time (months)
16*	163%	7	Yes	2
11	161%	8	Yes	1
36	155%	5½	Yes	1
8	130%	6	No	12
9†	144%	5	No	12
13	138%	10	No	5½
14	137%	4	No	7
10‡	145%	9	No	7
21	123%	8	No	5
22	135%	8½	No	5
23	114%	3	No	4 plus
30	130%	7	No	4
31	130%	7	No	2 plus
34	134%	6½	No	6
37	130%	6	No	1

\*This patient was again placed on thiouracil to which she responded, but subsequently had a relapse within a month.

†The basal metabolic rate was a single reading and too high when compared with the patient's clinical condition.

‡This patient had a basal metabolic rate which was not commensurate with her hyperthyroidism, due to the presence of a bilateral pneumothorax for pulmonary tuberculosis.

The reports of the frequency of recurrence without extended thiouracil therapy suggests that only patients presenting mild or moderately severe hyperthyroidism should be treated with thiouracil with the hope of medical cure in mind, whereas patients with more toxic hyperthyroidism should be treated with the idea of performing thyroidectomy as soon as the toxicity is eliminated. Perhaps the administration of thiouracil to the point at which exhaustion of the thyroid occurs (mentioned by Dunlop) would result in more prolonged remissions or cure of patients with even the most toxic cases. However, the end result of such therapy might be the production of a Riedel's struma, which is claimed to be the result of prolonged thyroiditis. Williams (78) has already noted perithyroiditis in glands removed after thiouracil therapy. The extreme hyperplasia of the thyroid produced by thiouracil, the tendency of the thyroid to produce adenomas and carcinoma *in situ* (19), as well as reports that thiourea and allied substances are carcinogenic (6) suggest that neoplasia might be a complication of prolonged thiouracil treatment, but so far no case of carcinoma due to thiouracil has been reported.

It is still too early to state how extensively thiouracil management can be utilized to the exclusion of surgery. Williams and Clute would perform surgery on those patients with very large goiters, those who are unwilling or unable to appear for the necessary frequent check-up examinations, and those who demonstrate undesirable reactions to thiouracil. The high percentage of malignancy in unilateral (solitary) nodular non-toxic goiters, as pointed out by Cole, Slaughter, and Rossiter, may be cited as a possible danger of leaving a thyroid nodule *in situ* permanently, if a permanent remission has been achieved by thiouracil in toxic nodular goiter.

Thiouracil is especially indicated in patients who are so toxic that operation following preparation with iodine is unsafe; likewise the drug is strongly indicated in thyrocardiac patients. Patients who are sensitive or refractory to iodine, as well as those who have concomitant tuberculosis, represent groups in which thiouracil is particularly advantageous. Hyperthyroidism of a low or moderate severity, and recurrent hyperthyroidism following thyroidectomy may constitute indications for medical management with thiouracil to the exclusion of surgery, although additional time for follow up will be required to settle this point.

#### SUMMARY

In an effort to evaluate the dangers and advantages of the use of thiouracil in hyperthyroidism, a study has been made of 1,573 case reports in the medical literature. The incidence of toxic reactions of all types is 13.77 per cent. The incidence of serious toxic manifestations is not over 4 per cent. The mortality rate in the reports reviewed is 0.57 per cent, although this figure is diminishing somewhat due to the use of less massive doses of thiouracil, and a more complete knowledge of the complications which may result from its use.

Occasionally, a sensitivity to thiouracil appears to have been created when the drug was discontinued and given again after a period of several weeks. However, we have noted no such sensitivity in 8 patients to whom the drug was given a second time.

An estimation of the duration of remissions resulting from thiouracil therapy cannot yet be made, although it would appear that prolonged remissions or cure can be expected only in patients having mild hyperthyroidism.

Surgical therapy seems indicated in severe hyperthyroidism, once it has been adequately controlled by thiouracil, because of the frequent rapid recurrence of symptoms after thiouracil has

been discontinued; surgery is still indicated in patients with large goiters, or goiters causing tracheal compression, as well as in toxic nodular goiters in which there is a question as to their possible malignancy.

Thiouracil will be much superior to iodine in the treatment of thyrocardiac patients. In patients who are sensitive to iodine, or who have tuberculosis, thiouracil will be especially useful. However, in a small percentage of cases, sensitivity to thiouracil will be so serious that iodine must of necessity be the drug for preoperative preparation.

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# ABSTRACTS OF CURRENT LITERATURE

## SURGERY OF THE HEAD AND NECK

### EYE

Kirby, D. B.: *Surgical Treatment of Strabismus*.  
*Am. J. Ophthalm.*, 1946; 29: 408.

Early surgery for strabismus, especially before the school age of from 4 to 6 years, is indicated. The decision to operate is dependent upon the following conditions: the cycloplegic refraction; the effect of the correction of the ametropia; correspondence; fusion; rotation; monocular and binocular tests in the primary and cardinal direction of gaze; occlusion; correction of amblyopia; excursive exercise; development of normal correspondence; and fusion training.

The surgical operations applicable to the correction of strabismus are as follows:

Tenotomy may be freely applied to the lateral rectus, but only guardedly to the medial rectus; myotomy is suggested for the inferior oblique in some cases of overaction; myectomy for resection of the rectus muscles and for extreme spasms or overaction of the inferior oblique muscle; resection, advancement or tucking for the recti and the inferior oblique muscles; recession or retroplacement for the recti and the oblique muscles.

Recession or retroplacement of a medial rectus muscle should not exceed 5 mm., and of a lateral rectus muscle, 6 to 7 mm.

For esotropia associated with convergence excess, early correction of the hyperopia may prevent the development of strabismus. Recession of one or both medial rectus muscles, or resection or advancement of the lateral rectus is usually necessary in cases of long standing.

For convergent strabismus associated with divergence insufficiency and unilateral or bilateral abduction paresis, resection of the lateral rectus in one or both eyes may be necessary.

For divergent strabismus associated with divergence excess, recession or tenotomy of one or both lateral rectus muscles may be indicated.

For divergent strabismus associated with convergence insufficiency (divergent strabismus greater for near than for distance), convergence exercise, appropriate lenses, and tenotomy or recession of one or both lateral rectus muscles, may be required.

For vertical deviations (hypertropia and hypotropia), tenotomy, recession, resection, or advancement may be used.

For spasm or overaction of the inferior oblique muscle, free myotomy or myectomy at the origin or at the insertion of the muscle may be indicated.

Preoperative study is recommended of the monocular vision, of refraction, accommodation, convergence, divergence, monocular and binocular un-

cover tests in all positions of gaze, degree of fusion, as well as proper diagnosis and orthoptic exercises.

In general, undercorrection is preferred to overcorrection, because the latter is difficult to reconstruct; and the function of an overactive muscle may be diminished by tenotomy, myotomy, myectomy, recession or retroplacement, and the action of a weak muscle may be enhanced by advancement or resection.

Orthoptic training after surgery is urged also as a means of accomplishing binocular single vision with depth perception.

JOSHUA ZUCKERMAN, M.D.

Atkinson, W. S.: *Corneal Section with Long Bevel and Conjunctival Flap for Cataract Extraction*.  
*Preliminary Report. Arch. Ophthalm.*, Chic., 1946, 35: 335.

By placing the corneal section in cataract extraction in the avascular corneal tissue and using a long bevel the author aims at the prevention of a leaky wound and postoperative hyphema. Incision is made with the keratome after a conjunctival flap has been dissected down from a point 4 mm. from the limbus, the keratome being introduced at the side of a previously placed McLean suture and at an angle to produce a long bevel. Withdrawing and partially reinserting the keratome with a sawing motion enlarges the incision, which is completed to one-half the circumference of the cornea with scissors. The amount of the bevel is decreased as the 180 degree meridian is approached. With the pupil well dilated the iris will frequently be concealed behind the corneal ledge; if it is not, from one to three iridotomies are made with the De Wecker scissors (with two sharp points), the iris not being grasped with forceps.

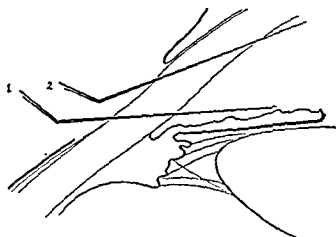


Fig. 1. 1, Usual angle of keratome incision; 2, long bevel obtained when the point of the keratome is directed away from the iris and toward the apex of the cornea.

This operation requires tumbling of the lens because of the forward position of the incision. If the capsule ruptures removal of the lens material is rendered more difficult. If the removal is to be accomplished without tumbling, as in the case of hypermature cataracts, the incision must be less beveled and placed farther back.

Results are tabulated in three series of 100 each; in the first a corneoscleral incision was made with a Graefe knife, in the second a keratome-scissors incision was made, and in the third operation was done by the method described. The number of postoperative leaky wounds was shown to be decreased in the third series, and while hyphema still occurred, the hemorrhages were smaller and less frequent. The visual results were also slightly better in the third group; in the first series 60 per cent of the patients had a visual acuity of 20/20 or better, in the second series 68 per cent, and in the third group 70 per cent.

WILLIAM A. MANN, M.D.

Laval, J.: Vogt-Koyanagi Syndrome. *Am. J. Ophth.*, 1946, 29: 536.

A detailed study of a case of Vogt-Koyanagi syndrome (bilateral uveitis with retinal detachment, poliosis, alopecia, and dysacusia) with several features of interest is presented. The patient was examined so early in the disease that the only abnormal finding was the presence of a few cells in the aqueous, the other findings developing while the patient was under observation. Iridectomies for secondary glaucoma in each eye gave opportunity for histological examination of the iris tissue which appeared extremely necrotic with a moderate amount of round cell infiltration and an occasional plasma cell.

The spinal fluid and aqueous were examined and animal inoculations were performed, all of which yielded no positive results.

WILLIAM A. MANN, M.D.

## EAR

Tumarkin, A.: A Contribution to the Theory of the Mechanism of the Auditory Apparatus. *J. Laryngol.*, Lond., 1945, 60: 337.

The author states it is now commonly thought that the ear is critically damped. He points out that such a system is not compatible with great selectivity. As a result, many authors have abandoned Helmholtz's resonance theory for the hydrodynamic theory of Rebaul, which is based on the propagation of a disturbance in a fluid column with elastic walls.

He reviews the evidence for critical damping and shows that the cochlear microphonic behaves differently from the nerve action potential. The former can follow a phase shift while the latter cannot. The subjective effect of phase shift is momentary silence. The decay period of a sound necessary to produce the sensation of immediate cessation is constant, regardless of the intensity. It is believed that the microphonic and the action potentials arise from two different structures—one is critically damped (probably

Reissner's membrane) while the other is resonant (probably the basilar membrane).

The author admits the necessity for great but not critical damping in the end organ in order to account for the analysis of complex sounds. He tries to reconcile great damping with high selectivity, and points out that frictional damping may be replaced by damping by reverse radiation in the ear. The round window dissipation of energy into the middle ear may be the damping mechanism, and this is large because of the overall good impedance matching that facilitates the absorption of sound energy from the air into the cochlear fluid.

The tension of the middle ear structures and their minute displacements indicate that frictional damping which is proportional to velocity is at a minimum here. The middle ear should be considered as a pressure-driven rather than a velocity-driven system. In such a system obliquity of the drum is no disadvantage and, indeed, by allowing a greater drum area, it has been found to be advantageous to sensitivity.

The inner ear on the other hand is considered to be velocity driven with the pressure gradient, started at the oval window, suddenly falling when it reaches the appropriately resonant basilar fiber. This fiber is undergoing maximum velocity and displacement, which is compatible with the findings in masking experiments. There are mass movements of finite columns of fluid with low impedance because of small frictional resistance.

If the middle ear is pressure driven, then the function of the intratympanic muscles is to hold the middle ear tense and insure close mechanical coupling of the ossicles. A primary listening function for these muscles is proposed, and, with greater sound intensity, some protection against overexcursion, although it is pointed out that even at 120 DB this is only .01 millimeter at the drum.

If damping in the cochlea occurs as a result of reverse radiation then frictional losses in the cochlea may be minimal. The action potential has been shown to be due to the half cycle produced by outward movement of the stapes. The author suggests that functional damping may occur only on the other half of the cycle (inward movement of the stapes). He suggests that the cochlea itself may, by shunting effects, protect itself against large stimuli. He then considers the function of the basilar membrane transversely, and points out the difference in sensitivity of the inner and outer hair cells. This may be used to explain recruitment and variations in pitch with intensity. The low impedance of the cochlea makes it possible for sound energy in air to directly activate the cochlea. The author states that this is clinically true and is dependent on a freely moveable stapes.

About a 10 DB threshold loss may be expected from a central perforation, about 25 DB from loss of the middle ear apparatus, and about 60 DB loss if an extensive fibrosis of the stapes is also present.

JOHN R. LINDSAY, M.D.

Lierle, D. M., and Reger, S. N.: Correlations between Bone and Air Conduction Acuity Measurements over a Wide Frequency in Different Types of Hearing Impairment. *Laryngoscope*, 1946, 56: 187.

The authors believe that as long as significant differences of opinion exist with regard to the efficacy of different test methods and the interpretation of results, further work along these lines seems pardonable, if not necessary. In their study, the attempt is made to present a description of the instruments, techniques, experimental controls, and results, that will not add to the general confusion but will be instrumental in clarifying certain test procedures, objectives, and interpretations of the functional examination of hearing.

The following aspects of bone conduction acuity measurements are discussed:

1. Difficulties involved in tuning fork measurements.
2. The "air-conduction bone-conduction differential" of audiometer vibrators.
3. Results of audiometric measurements.
4. Masking of bone conducted sound.
5. The Weber, Schwabach, and Rinne tests with the bone conduction vibrator.
6. The Gelle, Bing, and occlusion tests with the vibrator.
7. Increased bone conduction acuity.
8. Disproportionately decreased bone conduction acuity.
9. Threshold of vibration by bone conduction.
10. Reliability of audiometer bone conduction vibrators.
11. Interpretation of the relationships between air and bone conduction acuity threshold measurements.

Because of the obvious difficulties involved in obtaining accurate quantitative bone conduction measurements with forks, attention next was directed to a study of certain physical characteristics of a new type of electrically activated bone conduction receiver or vibrator which was designed for use with the audiometer. This particular vibrator is constructed so that its energy output is practically free from variations due to the amount of pressure with which it is held against the skull.

The results of bone conduction measurements obtained with the vibrator used in this study in no way contradicted or disagreed with the findings from measurements with forks. The vibrator demonstrated superior or desirable characteristics in the following respects:

The vibrator makes possible the testing of bone conduction acuity in terms of measurements which enable direct immediate comparison between the air and bone conduction acuity.

The vibrator permits the testing of bone conduction acuity (Schwabach) over wider frequency and greater intensity ranges than is possible with forks.

Air and bone conduction acuity determinations obtained in the same measurement terms give the

information sought in the Rinne test over wider frequency and intensity levels than are possible with the forks.

The Weber test can be performed over wider frequency and intensity levels than can be accomplished with the forks.

The Gelle, Bing, and occlusion tests can be conducted with a higher degree of accuracy with the vibrator than is possible with forks.

Increased bone conduction is a real phenomenon, but is of such rare occurrence that it may be considered the exception rather than the rule in cases of middle ear impairment.

Increased bone conduction is of most frequent occurrence for frequencies below 1,500 cycles.

A given patient may exhibit both increased and decreased bone conduction in the same ear simultaneously—increased for low, and decreased for high frequencies.

It is more difficult to achieve effective masking for bone conduction than for air conduction measurements.

Properly constructed, calibrated, and used bone conduction vibrators possess sufficient reliability and accuracy to justify their use.

The development of such a vibrator for general use will constitute a progressive advancement in the functional examination of hearing.

JOHN F. DELPH, M.D.

Lempert, J.: Tympanosympathectomy; A Surgical Technique for the Relief of Tinnitus Aurium. *Arch. Otolaryng.*, Chic., 1946, 43: 199.

During the past twelve years the author has been conducting a study of the problems of tinnitus in relation to disease of the middle and inner ear. Many observations were made on both the suppurative and the nonsuppurative type of otitis media.

The most striking observation was the extreme rarity of tinnitus in patients suffering from long standing suppurative lesions with polyp and cholesteatoma involving the tympanum proper. This fact suggested, among other things, that tinnitus may be the result of inflammation of some anatomic structure which is normally present within the tympanic cavity.

In a series of 100 patients complaining of tinnitus, upon whom the fenestration operation for otosclerosis was being performed, there was frequently observed an abnormal congestion of the mucoperiosteum covering the cochlear promontory.

In another series of 60 patients who were operated upon for chronic otorrhea, the normally present tympanic plexus with its branches was found to be absent.

On the basis of his observations, the author believes that many cases of tinnitus aurium may be a tonus impulse transmitted from the middle ear by the tympanic plexus to the inner ear.

The author has devised an operation for the relief of tinnitus aurium, without damage of the hearing acuity of the patient. The operation has been per-

formed on 15 patients, 10 of whom were freed of their tinnitus.

JOHN F. DFLPH, M.D.

Syvertson, J. T., Hess, W. R., Krafchuk, J., Josselyn, E. H., and Others: Otitis Externa; Clinical Observations and Microbiological Flora. *Arch. Otolaryng.*, Chic., 1946, 43: 213.

Otitis externa is a clinical entity with a high morbidity in military personnel on tropical duty. The microbiological flora of the external auditory canal in otitis externa, which in most cases is mixed, differs from the flora of the normal auditory canal in the same clime by the inclusion of one or more pathogens. The causative agent of otitis externa can be any one of a variety of bacteria and fungi. Among these are *Pseudomonas aeruginosa*, *Klebsiella ozaenae*, *Staphylococcus aureus hemolyticus*, *Aspergillus*, and probably *Monilia tropicalis*, *Actinomyces*, and *Proteus*. The role of fungi in otitis externa has undoubtedly been overemphasized, whether as primary or secondary agents of infection.

As the response to treatment in otitis externa is determined by the causative agent present, exudate from each ear should be cultured before treatment is started. The efficacy of each of the medicinal preparations and antibiotic drugs recommended for treatment of otitis externa should be tested by employing groups of 20 cases in which the etiological factors are known.

NOAH D. FABRICANT, M.D.

Eagle, W. W.: Secretory Otitis Media. *Ann. Otol. Rhinol.*, 1946, 55: 55.

The newer method of incising the ear drum and aspirating the fluid in patients with secretory otitis media (formerly known as catarrhal otitis media) has, in the author's hands, shown excellent results. The author states that complications are practically nil. Of 172 patients so treated only 1 developed purulent otitis media following myringotomy and aspiration of the nonpurulent fluid.

The author offers no definite causative factor which would account for the increased frequency of the disease, although it is known that blockage of the eustachian tube is the primary cause of secretory otitis media. It is possible that the entity may be virus-induced, since the disease is almost epidemic in form. Although secretory otitis media is more prevalent during the colder months of the year, it is not necessarily associated with upper respiratory infections.

NOAH D. FABRICANT, M.D.

Johnston, C. M.: The Treatment of Chronic Otitis Media. *J. Lar. Otol.*, Lond., 1945, 60: 303.

The author maintains that the successful treatment of chronic suppuration of the middle ear depends on a correct appreciation of its cause. Infected granulation tissue is often the sole cause of chronic suppuration, and its removal will frequently cure the otorrhea. In many instances the cause of the condition is in the nose, the paranasal sinuses, or in the pharynx, and if it is discovered early, irreparable damage may be prevented.

Infection of the sinuses is a common cause of chronicity of otitis media. Poor general health, exposure to the elements, and bad housing conditions undoubtedly aid other factors in keeping the infection active, which explains in part the frequency with which such diseases tend to relapse under conditions of active military service, and the good results obtained by hospitalization of patients.

In the conservative treatment of a suppurating ear, it is most important that pus and debris be removed from the meatus at frequent intervals. Polyps and granulation tissue should be removed at the earliest opportunity. These opinions are based on the experience of the author at the Horton Emergency Hospital.

NOAH D. FABRICANT, M.D.

Banham, T. M.: The Treatment of Chronic Otitis Media. *J. Lar. Otol.*, Lond., 1945, 60: 307.

The author reports a series of 200 cases of chronic otitis media and describes the results obtained with the conservative method of treatment used at one Royal Air Force clinic. The cases are grouped according to their otoscopic appearance.

In conclusion, the author states that the satisfactory end result of conservative treatment is not unlike the successful result of operative treatment. He believes that with operative treatment, deafness is much more likely to be increased, whereas with conservative treatment, hearing is often improved. However, if, in the event of a recurrence, the ear is likely to be neglected and further treatment is not obtained, some form of radical mastoidectomy is probably a safer procedure.

NOAH D. FABRICANT, M.D.

Lodge, W. O.: Operative Treatment of Chronic Otitis Media. *J. Lar. Otol.*, Lond., 1945, 60: 315.

The author believes that since chronic otitis media implies degeneration, successful operative treatment cannot be assured, and that treatment of the disease remains a tantalizing problem. Nevertheless, in his hands the proportion of good results has been sufficiently high to atone for occasional disappointments, and it is believed that operation may be of value if it can be discerned from successes and failures how the disease can be prevented.

In 78 of 100 patients, healing has been complete. The successful results do not include cases in which only the mastoid cavity proper was healed, but do include cases in which the cavities remained dry, provided keratoses were not neglected.

Operations by the endaural route allow observation of living pathology and correlation with x-ray appearances of pneumatization, thus harmonizing treatment with surgical principles and affording research into the prevention of chronic otitis media.

The newer antiseptics affect the after treatment of this condition.

The transmeatal approach is described, and measures to enlarge the lumen of the meatus and avoid perichondritis are discussed.

NOAH D. FABRICANT, M.D.

Thornell, W. C., and Williams, H. L.: Apical Petrositis; Medical and Surgical Management in Cases with and without Complicating Meningitis. *Arch. Otolar.*, Chic., 1946, 43: 393.

Three cases of apical petrositis are presented because they illustrate the solution of the problems presented in the medical treatment and surgical management that the otologist may encounter in cases of petrositis with or without complicating meningitis. These cases stress the importance of a careful and complete history. They demonstrate the need for adequate and primary surgical treatment in instances in which symptoms of petrous involvement develop in the presence of an apparently adequately draining ear, and they discourage dependence on chemotherapy alone. They show the necessity for approaching each case as an individual problem. The selection of the surgical approach is not planned prior to operation but is determined at the time of operation according to the anatomicopathological changes present.

Prior to operation on the petrous pyramid, the preparation should be such as to place the patient in the best possible physical condition. It is advisable that the treatment of complicating meningitis should be well under way, preferably with a combination of sulfonamide compound and penicillin. The sulfonamide which we have found to be clinically superior at the present time is sulfadiazine. When used alone in cases of meningitis, it is advisable to maintain a blood level of 18 to 20 mgm. per 100 c.c.; this has been found to be adequate. In cases of petrositis without complicating meningitis, when using sulfadiazine alone, blood levels of 10 to 12 mgm. per 100 c.c. are advisable. When using large doses of sulfadiazine it is very important that adequate fluid intake and output be maintained. The intake should be 3,000 cubic centimeters per day, and urinary output 1,500 cubic centimeters or more. Even though the fluid intake may be adequate, renal complications may occur if the dose of sulfadiazine is high. This may be prevented by adequate alkalization.

The combination of a sulfonamide and penicillin produces a synergistic effect. In cases of meningitis, penicillin should be administered intrathecally as well as intravenously (or intramuscularly) because of the fact that penicillin does not pass freely to the spinal fluid from the blood stream. After the meningitis has been brought under control it is necessary to eradicate the disease in the petrous pyramid surgically because, unless this is done, the infected focus may lie dormant, protected by a layer of necrotic material and pus, and then will become reactivated after the withdrawal of chemotherapy and penicillin. Apical petrositis with its high incidence of intracranial complications is not a condition in which it is safe to temporize, although such a course may be followed with occasional success in cases of uncomplicated mastoiditis if the patient is under careful observation.

When possible, drainage of suppurative foci in the petrous pyramid should be accomplished by follow-

ing preformed cell tracts to the involved region. When a cellular pyramid is present, increased room in and around the region of the labyrinthine capsule is usually present. If adequate drainage can be secured by following the perilyabyrinthine cell tracts, well described by Ramadier, the necessity of destroying the hearing can be avoided. Therefore the authors believe that drainage of apical petrositis should be done in stages, the perilyabyrinthine regions being first explored and the more destructive procedure of complete apicectomy being reserved for a later date if it is subsequently found necessary. If closed apicitis is present, in which preformed tracts cannot be found on careful and extensive exploration of the perilyabyrinthine regions, complete apicectomy by the Ramadier-Lempert technique is indicated without further delay. If history and examination definitely indicate a suppurative region in the pyramid medial to the capsule of the labyrinth, adequate drainage must be secured.

The performance of complete mastoidectomy alone, followed by a period of observation, is a policy that should be pursued only when there is a reasonable doubt that the symptoms represent apicitis. As has been pointed out by one of the authors (Williams), disease sealed off in the cells along the sigmoidal angle is capable of producing a Gradenigo syndrome, and such infected cells may have been overlooked. This should rarely happen, however, if an adequate exploration of the mastoid cells has been done. If meningitis is present and no adequate explanation for its presence is presented during the course of complete mastoidectomy, the dura should be uncovered both over the temporosphenoidal lobe and over the sinus and cerebellum. If still no explanation of intracranial extension of the disease is found, apicectomy should be seriously considered, because of the frequency with which apicitis has been found to be the underlying cause of such extension. The association of chronic sphenoiditis with apicitis, as pointed out by Eagleton, should be borne in mind.

## NOSE AND SINUSES

Wright, R. W., and Boyd, H. M. E.: Aerohematoma of the Sinuses. *Arch. Otolar.*, Chic., 1946, 43: 357.

Aerohematoma is suggested to designate a hematoma which may occur in the mucosa of a paranasal sinus after failure of the sinus ostium to admit air during sudden descent from a high altitude.

Twelve such cases are reported, in 9 of which the frontal sinus was involved; in 2 cases, and possibly 3, both the frontal sinus and the antrum were involved, and in 3 the antrum alone was involved.

The outstanding symptom is rapid onset of severe pain either over the frontal region or, in the case of the antrum, over the side of the face and teeth. The sharp pain soon subsides, leaving soreness which lasts for several days. The location of the pain is indicative of the sinus involved.

Eight of the twelve patients had a slight cold or sinusitis at the time of flight; the others had no ob-



vious predisposing pathological condition. The amount of pressure necessary to pull the mucosal layers apart, and to rupture small vessels and form a hematoma, is slight. Descents from around 5,000 feet may produce the lesion. The hematoma may develop slowly and not be demonstrable on x-ray at once, but later a well defined shadow appears and in a day or two the entire sinus may become cloudy. Resorption requires from 3 to 10 weeks. There may or may not be free hemorrhage from the sinus.

The treatment consists of nasal shrinkage, and surgical intervention is rarely necessary.

JOHN R. LINDSAY, M.D.

### MOUTH

Stenstrom, K. W., and Waldron, G. W.: Transitional Cell Carcinoma. *J. Oral Surg.*, 1946, 4: 175.

The authors report a case of extensive transitional cell carcinoma without glandular metastases, occurring in the upper jaw of a woman aged 48. Treatment with deep x-ray therapy by which a tumor dose of 1,200 tissue roentgens were delivered, resulted in a disappearance of the tumor with no recurrence after a period of 11 years. The term "transitional cell carcinoma," they believe, should be retained since this tumor is especially radiosensitive. They consider it to be the same as a lymphoepithelioma.

JOHN R. LINDSAY, M.D.

### NECK

Bechgaard, P.: Tendency to Hemorrhage in Thyrotoxicosis. *Acta. med. scand.*, 1946, 124: 79.

Observations over a period of many years have indicated a disturbance of the coagulation of the blood in thyrotoxicosis. A toxic hepatitis leads one to expect a decrease in coagulation of the blood because of a reduction of prothrombin.

The present study comprises the results obtained in the treatment of 50 patients with thyrotoxicosis (45 women and 5 men). Forty-one of the patients were operated upon during the period of this investigation. Routine and special blood studies were carried out on the patients. The author found no relation between an increase in metabolism and the clotting time of the blood, or the prothrombin content of the blood. The fibrinogen was not lowered, but in several cases it was increased. In a few of the patients the bleeding time was increased. The clotting time for patients with thyrotoxicosis is prolonged. In all cases the antithrombin content of the blood was within normal limits. Transitory urobilinuria was observed in 9 cases. There appeared to be no relation between the decrease in the prothrombin content of the blood and its coagulability. In 8 cases the bleeding time was increased. The antithrombin and fibrinogen content of the blood, the thrombocyte count, and the clot retraction were found to be normal.

RICHARD J. BENNETT, JR., M.D.

Lederer, J.: Particular Aspects of Osseous Growth and Calcium Metabolism in a Case of Exophthalmic Goiter in a Child of 6 Years (Aspects particuliers de la croissance osseuse et du métabolisme calcique dans un cas de goître exophtalmique chez un enfant de six ans). *Ann. endocr.*, Par., 1946, 7: 34.

In the case here reported the child (a girl of 6 years) had had a normal birth and development until 4 years of age when she underwent a tonsillectomy and soon afterward began to grow rapidly in height. Also about this time the parents noted that the thyroid gland had begun to enlarge and the child became very nervous, was extremely restless, always complained of being "hot," sweated copiously, and developed a voracious appetite.

Examination disclosed a tall, thin child with mild exophthalmos, a slight sign of Graefe's disease, and a pronounced tremor. During the period of medical treatment and preparation for surgery the patient exhibited an abnormal rate of growth in height, and her dentition and ossification was that of a child several years older; yet there was widespread evidence of osteoporosis and a highly unfavorable (negative) calcium balance.

After removal of the orange-sized, firm, diffusely hyperplastic goiter by means of a subtotal thyroidectomy the rate of skeletal growth returned to normal and the calcium balance showed a positive balance, which is normal for this period of childhood.

JOHN W. BRESNAN, M.D.

Swann, C. G.: Deep Infections of the Neck with Particular Reference to the Role of Dental Foci. *Ann. Otol. Rhinol.*, 1946, 55: 29.

Dental diseases of the lower jaw are a most frequent source of deep infections involving the fascial planes of the neck; yet it is remarkable that relatively few complications follow the numerous dental procedures carried out in a constantly infected field. Careful and frequent observation following dental procedures of the lower jaw is of the utmost importance.

The hyoid bone and mylohyoid diaphragm serve to divide the neck into an upper and a lower compartment. The mylohyoid muscle is hung like a broad hammock from the mylohyoid ridge of the mandible to the hyoid bone and fuses superficially with the deep cervical fascia. Division into potential spaces results from deep projections of the superficial layer of the deep fascia. Each space is so limited by dense fascia and muscle attachments that much pressure must be exerted before infection extends into adjacent areas. It must be kept in mind that these anatomical subdivisions apply to potential spaces only; that is, areas containing connective tissue and occasional glands. A cavity develops only after infection creeps in and suppuration takes place.

The streptococcus is the predominant organism, with the spirochete of Vincent nearly always present. There is marked edema, and the intracellular spaces

are filled with a serous, somewhat hemorrhagic exudate.

Painful swelling in the suprahyoid region of the neck following any dental procedure, trauma of the lower jaw, or in the presence of dental disease is the first sign of deep infection. The area involved is brawny or boardlike, and tender; only rarely is fluctuation present, and then, late in the disease. The swelling usually spreads rapidly, but the course may be mild for several days and then suddenly assume an alarming character. In the beginning there is no redness of the overlying skin, but edema is present and there is no pitting on pressure. Infection of the parotid space is often rapidly followed by involvement of the lateral pharyngeal space.

When an abscess is located definitely in the submental space, a midline incision in the submental triangle, extending from the symphysis to the hyoid bone, is made. The relief of tension and the establishment of drainage are usually all that is necessary to provide prompt and rapid recovery. Occasionally an abscess will point just beneath the mucosa of the floor of the mouth, between the tongue and the medial surface of the alveolus. Free incision and gentle exploration are indicated.

For a submaxillary abscess, the incision should begin just anterior to the angle of the jaw and pass forward parallel to and about 1 centimeter below the mandible for three-fourths of the distance to the midline anteriorly. It will divide the skin, platysma, cervical fascia, mylohyoid muscle and the anterior belly of the digastric muscle. The only large vessels encountered are the facial artery and vein as they pass up the posterior lateral side of the submaxillary gland; these are isolated, ligated, and cut.

Supportive disease of the parotid calls for massive drainage of the gland. This is obtained best by an incision which starts above, near the zygoma, immediately in front of the ear, extending downward to a point beneath and well in from the angle of the jaw. The skin and subcutaneous tissue are then reflected forward, which permits a wide exposure of the entire gland. Incision may be made to a considerable depth within the gland without danger of injury to the facial nerve, as these fibers lie rather deep. For abscess in the pterygomaxillary space, an incision is made along the superior border of the zygoma, and the fibers of the temporal muscle are dissected to expose the infratemporal fossa. A grooved director or small hemostat is directed downward and inward under the zygomatic arch for a distance of from 1 to 1½ inches, and entry made into the pterygomaxillary space.

When the lateral pharyngeal space is involved secondarily after operative treatment on the submaxillary and sublingual areas, the original incision is carried directly backward and slightly upward following the curve of the mandible, to the anterior border of the sternomastoid muscle. Many surgeons prefer the T-shaped incision of Mosher, particularly when the principal area of involvement is in the lateral pharyngeal space. After division of the super-

ficial tissues and cervical fascia, Barnhill selects his entrance on a line from the middle of the submaxillary gland to the middle of the parotid. A dull dissector is inserted and passed inward and upward in the direction of the tonsillar fossa, and an index finger in the pharynx, placed just anterior to the tonsil, will detect the end of the approaching instrument. When the posterior compartment of this space has become involved it may be necessary to investigate the carotid sheath, or its contents. When the carotid sheath presents even slight pathological changes, it should be opened and its contents inspected. Particular attention is given to the internal jugular following previous intermittent chills and a septic type of temperature. If the vein is thrombosed, the limits of the clot are determined and the vessel is ligated above and below the involved area. If the thrombus in the internal jugular is below the entrance of the facial vein, this should be ligated and the diseased portion of the internal jugular excised and removed.

A tracheotomy is done when there is marked difficulty of respiration. The type of anesthetic employed in the various operations described is important. Local anesthesia is satisfactory in mild uncomplicated cases requiring simple incision and drainage. Intravenous anesthetics have been used with good success. Inhalation anesthetics may be used if the airway is free. Nitrous oxide is not recommended, however, because of the high incidence of spastic respiratory obstruction. EARL O. LATIMER, M.D.

**Lederer, F. L., and Howard, J. C.: Wartime Laryngeal Injuries.** *Arch. Otolaryng.*, Chic., 1946, 43: 331.

This series of 43 cases includes some of the most representative types of laryngeal injury. The reports of 8 cases of indirect injury to the larynx have been abstracted, and the authors present 1 case of thermal trauma to the larynx and 2 cases of indirect trauma to the larynx.

The immediate treatment is always directed toward maintaining the patency of the airway; external injury may cause edema and subsequent suffocation. During the lifesaving measure of inserting a tube into the larynx or trachea, sedatives should be used sparingly. Vessels should be ligated carefully, and the wound should not be sutured too tightly because of the danger of emphysema. The authors believe that direct laryngoscopy is of great importance (before treatment is instituted) as a means of determining the amount of pathology in the larynx.

The most frequent complication of laryngeal injury is perichondritis. In cases in which the perichondrium has been injured, many complications may result. The occurrence of tracheo-esophageal fistulas is common; stenosis and web formation frequently follow laryngeal injury.

Débridement within the larynx is contraindicated. In the present series of cases, the more conservative type of surgical procedure was followed with excellent results. Stenosis of the upper part of the larynx may be treated by the use of core molds. Following

laryngectomy, an esophageal voice must be developed.

RICHARD J. BENNETT, JR., M.D.

Cutler, M.: Cancer of the Larynx; 5 Year Results of Concentration Radiotherapy. *Arch. Otolar.*, Chic., 1946, 43: 315.

One hundred eighteen consecutive cases of carcinoma of the larynx, which were treated by irradiation from April, 1938 through December, 1942, are reported. In this series 42 per cent 5 year cures and 39 per cent 3 year cures were obtained.

When the cords are freely movable or only partly fixed by carcinoma, the curability is high. However, when the cords are completely fixed, cure is less common and laryngectomy is indicated.

This study shows that a group of patients with intrinsic squamous carcinoma of the larynx too advanced for laryngofissure and requiring total laryngectomy have been cured by irradiation. Laryngectomy should be limited to intrinsic lesions with complete fixation of the cords in good surgical subjects with a good life expectancy.

RICHARD J. BENNETT, JR., M.D.

Dargent, M., and Papillon, J.: Motor Disturbances following Excision of Lymph Glands of the Neck. How May We Avoid Them? (Les séquelles motrices de l'évidement ganglionnaire du cou. Comment les éviter?) *Lyon chir.*, 1945, 40: 718.

Prophylactic excision of the lymph glands in the course of treatment of oral cancer may produce a

paralysis of the lower branch of the facial nerve and certain muscles of the shoulder, especially the upper portion of the trapezoid muscle.

It is essential in the dissection of the cervical lymph glands to preserve the facial nerve. It is highly desirable to preserve the cervicospinal anastomosis and the trapezoid branches of the cervical plexus, which prevent dropping of the scapula and permit normal elevation of the arm. It is possible to remove completely the upper and lower groups of lymph glands located underneath the trapezoid muscle and yet to preserve the most important nerves.

The authors dissected 30 anatomic specimens to study the location of the facial nerve and 12 specimens to investigate the location of the spinal nerve and the cervical plexus. The best way to preserve these nerves is to dissect the glands from above downward and from the anterior toward the posterior region. The technique is described in some detail.

Integrity of the muscles in the involved regions was established in 18 of 20 patients from 6 to 9 months after employment of the method advocated by the authors.

Failure in one of the cases was ascribed not to the surgical procedure but to a necrosis of the bones of the lower jaw following radiotherapy. No failure was recorded in 11 cases in which preservation of the spinal nerve had been attempted.

JOSEPH K. NARAY, M.D.

# SURGERY OF THE NERVOUS SYSTEM

## BRAIN AND ITS COVERINGS; CRANIAL NERVES

Falconer, M. A.: Surgical Problems In the Later Stages of Penetrating Head Injuries. *Austral. N. Zealand J. Surg.*, 1945, 15: 75.

This article was given as a lecture before the New Zealand branch of the Australasian College of Surgeons. It has to do with the surgical problems in the later stages of penetrating head injuries.

The author points out that the chief risks of in-driven foreign bodies are epilepsy and abscess formation. Few retained foreign bodies, whether metallic or bony, are likely to cause these complications unless they are actually lodged in the cortex or are al-

ready infected. If an adequate operation has been performed shortly after infliction of the wound, such foreign bodies will have been removed. Metallic fragments from projectiles are sterilized by the heat of the explosion, and those that penetrate deeply into the white matter usually remain silent. Therefore, deeply situated metallic bodies are best let alone unless they become implicated in a brain abscess. Once the original wound is healed, it is folly to attempt to remove a foreign body at a secondary operation, unless it is causing epilepsy or seems likely to do so. If this principle is not followed many patients will be worse off after than before operation.

It is pointed out that following the first World War post-traumatic epilepsy occurred more fre-



Fig. 1. Operative findings in Case 1. Top inset shows siting of scalp and bone flaps in relation to the skull defect. Left, The appearance after reflection of the bone flap; the metallic fragment has partially penetrated the dura. Right, The appearance after reflection of the dura; the foreign body has invaginated the brain immediately behind the excitable motor cortex, which has been mapped out by a thyatron stimulator. The bottom inset shows an intact cortical vessel coursing beneath the foreign bodies, as revealed during their removal.

A. Twitching, left side of mouth. B. Twitching, left eyelids. C. Twitching, left arm. D. Twitching, left arm. E. Silent. F. Stiffening of left arm, muffled voice.

quently in pensioners in whom foreign metallic bodies had been removed at a secondary operation, than in those in whom the foreign bodies had been left undisturbed. The instance was 53 per cent in the first group as opposed to 38 per cent in the second group. The reason for this disparity between these two groups is undoubtedly the additional trauma, which was so frequently inflicted upon the brain by ill judged attempts at removal. These statistics, however, should not deter one from recommending operation in properly selected cases, for it is well known that in the right type of case benefit can frequently be conferred by careful removal of a foreign body.

The author then gives 4 case studies, the first of which is an example of a superficially situated foreign body which caused the symptoms and was removed at an early stage. Case 2 is an example of a superficially situated foreign body causing symptoms, which was removed at a later stage. Case 3 is an example of a deeply situated metallic foreign body, the removal of which was not contraindicated. Case 4 is another example of a deeply situated metallic fragment, the removal of which was not indicated. It is pointed out that foreign bodies, unless actually lodged in the cortex, do not of themselves cause epilepsy, and need not be disturbed unless they are associated with an inflammatory lesion. The paramount importance of an adequate trial of medical treatment before excision of a brain scar is stressed.

The author then gives his method of repairing skull defects by the use of split-rib grafts.

The treatment of recurrent and delayed cerebral abscesses is discussed and a series of cases is described. Many pneumoencephalograms and other roentgenograms are given.

Finally the author discusses the excision of brain scars which are causing post-traumatic epilepsy. The frequency with which epileptic attacks occur after penetrating skull wound has been estimated from as low as 9.8 per cent to as high as 45 per cent. In the selection of patients for operation, there are two principles to be considered. The first concerns the time of the onset of attacks, the author expressing the opinion that excision of the brain cicatrix should not be contemplated until more than 2 years have elapsed since the wound was inflicted. The second, which is the more important, is that no patient should be submitted to operation unless a adequate treatment with phenobarbital and other anticonvulsant drugs has been tried and has failed. It is important that the scars should be widely excised. For this reason the author operates through a bone flap rather than through a trepanation.

Peter Martinez, M.D.

Carmody, J. T. B.: The Repair of Cranial Defects with Special Reference to the Use of Cancellous Bone. *J. Neurology*, 1944, 134, 303.

Tantalum has been used very successfully in the repair of large and extensive cranial defects. On certain occasions, however, it appears to act as a

foreign body and may have to be removed. The author had 2 such cases. In place of tantalum, he recommends the use of cancellous bone in small and medium sized defects.

Following the making of the flap incision, the aponeurosis is dissected to the edge of the bone defect, and the scar, which may begin at the margin of the defect, is carefully dissected from the dura. It is most important not to pierce through the scalp area to its external surface. All bleeding points must be meticulously controlled, and it is believed this best accomplished with fibrin foam packs. Freshening up the bone edges around the defects should be done to preclude the opening of diploic vessels. Cancellous chips averaging 1 centimeter in diameter are planed in mosaic layers, entirely filling the defect. Chips of this size are readily obtained by lifting them off the graft with the rongeur. As a final step, the pericranium surrounding the exposed bone defect is freed and turned back over the borders, partially enclosing the cancellous chips. The scalp flap is sutured in its light compression dressing is applied.

The method of taking the graft is as follows: The crest of the ileum is exposed and the fat surface of the bone laid bare. The outer cortical layer is split with a rotary bone saw and turned down. The strips of the medulla are sliced free, and when a sufficient amount has been obtained the cortical layer is replaced and sutured into its former position.

With the foregoing technique the author has had excellent success in the repair of small and medium sized defects. He recommends the use of tantalum in defects of the orbital ridge and frontal areas, though cancellous bone has been used in these positions.

John W. Fenn, M.D.

Wright, R. D.: Concussion and Contusion. *Surgery*, 1945, 19, 651.

The author discusses the mechanism of concussion and contusion with regard to the forces applied to the head. The possible results of applying free, free, stationary head are:

1. Linear acceleration of the whole skull and its contents in the line of the applied force.

2. Angular acceleration of the whole skull and its contents about an axis within or without the cranial bony laminae.

3. Distortion of the skull, with the production of the most resilient bony structures of the skull, transverse waves which are highly damped by the liquid loading of the contents and surface meninges.

4. Distortion of the skull, with the production of a general change in pressure within it.

The author has conducted experiments with cats to further determine the effects of free motion of the cranial contents. It was concluded that the effects of concussion and contusion is that of displacement of the elements of the neuraxis. The most extensive displacement is in the part of the neuraxis farthest away from the neck. It may occur in the parietal area when the head is rotated 90 degrees. It may result from distortion of the cranial contents and

may also result from the liberation of bubbles of the intracranial blood in areas of reduced pressure.

HOWARD A. BROWN, M.D.

**Reichert, F. L.: The Surgical Treatment of Vascular Anomalies of the Premotor Area Producing Epilepsy. *Surgery*, 1946, 19: 703.**

The author reports a series of 15 cases in which vascular anomalies of the premotor area were encountered as the cause of epileptic attacks. These attacks were of jacksonian character, and a presumptive diagnosis of "vascular anomaly" was made as a result of the history, neurological examination, and pneumographic studies.

In 9 of the patients, premotor signs were present.

Various types of vascular anomalies were encountered, including cortical angiomata or hemangiomas, dural angiomata, and callosal angiomata. The patients were treated by surgical exploration and coagulation of the abnormal vessels. This procedure frequently produced a transient hemiplegia until normal collateral vascular channels developed.

Subtemporal decompression was employed in some instances, as well as intravenous hypertonic solution and ventricular puncture, to effect a smoother postoperative course.

Two of the 15 patients had only temporary relief from the procedure, 7 were benefited with milder and less frequent attacks, and 6 (40%) were completely relieved following surgery.

HOWARD A. BROWN, M.D.

**Schueler, A., and Morgan, F.: Cephalohematoma Deformans. *Surgery*, 1946, 19: 651.**

Although most cases of infantile cephalohematoma are completely absorbed and leave no residue, it is known that calcification and bizarre osteoblastic and osteolytic changes may occur. These are rare, however, and this presentation of 5 cases studied many years after the onset give valuable roentgenologic data of this condition. The ages of the patients were 72, 71, 54, and 27 years.

The lack of surgical or postmortem examination, however, leaves some doubt in regard to the actual pathological state of the tissue and hence complete verification remains in some doubt. However, biopsy in 1 case revealed a pressure necrosis of the bone, primarily traumatic in origin, with induced hemorrhage and rarefying osteitis.

In 4 of the cases a definite history of trauma, occurring either in infancy or childhood, was present, while in the remaining case the swelling was noted since childhood. There was no evidence of neurological disturbance, and despite rather severe deformity it was believed that surgery would not be required.

The pathological picture is that of newly formed bone with osteoporosis and osteosclerosis forming sequestra and cysts. The new bone originally forms along the elevated pericranium, the dura mater, and, finally, within the swelling. Fresh hemorrhages may occur and partially destroy the swelling, even many

years after the trauma. Usually the paranasal sinuses are not developed on the ipsilateral side.

Roentgenologically there is a peculiar circumscribed hyperostosis involving the calvaria and base of the anterior part of the skull. The eccentric conformation with cystic cavities, osteoporotic and osteosclerotic areas suggestive of Paget's disease, and eburnated hyperostosis in the base all combine to make the picture fairly characteristic.

JACK I. WOOLF, M.D.

**Tschiasny, K.: The Site of the Facial Nerve Lesion in Cases of Ramsay Hunt's Syndrome. *Ann. Otol. Rhinol.*, 1946, 55: 152.**

Ramsay Hunt's syndrome designates the occurrence of herpes zoster at the cephalic extremity, particularly at the auricle and usually associated with neural signs of the seventh and eighth cranial nerves. Hunt explained the syndrome in the following way: inflammation of the geniculate ganglion produces herpes in the "geniculate area," that is, the part of the auricle receiving its sensory supply from the seventh cranial nerve. This inflammation causes sufficient pressure on the motor fibers of the seventh nerve to cause paralysis. On the other hand, herpes of the face or of the occipitocollar region was thought to be due to inflammatory lesions of the gasserian ganglion or of the first and second cervical ganglia, respectively, and the associated facial paralysis was believed to be produced by inflammation of the geniculate ganglion which was not of sufficient magnitude to cause herpes of the geniculate area but yet sufficient to cause facial palsy.

This concept has not been universally supported. At autopsy in a case of occipitocollar herpes associated with facial palsy Denny-Brown, Adams, and Fitzgerald found destructive lesions of the second cervical ganglion, inflammatory in nature, and patchy infiltration in the course of the facial nerve, but no changes at all in the geniculate ganglion.

The author makes a careful analysis of the seventh cranial nerve. He divides it into four parts for the purpose of better localizing the section of the nerve which is affected in various types of cases.

1. Infrachordal—all of the nerve distal to the branching of the chorda tympani. In lesions of this part of the nerve, there is motor paralysis of the face, the posterior auricular muscle alone escaping if the lesion is extracranial, but if the lesion is in the intracranial portion of the nerve, this muscle is involved also. Further, if the lesion is extracranial, sensation at the geniculate zone of the auricle is not disturbed, but if it is intracranial there are disturbances of sensation in this area. The sense of taste, and movements of the palate are normal. There is hyperlacrimation and epiphora. There are no signs of stapedius involvement.

2. Suprachordal—the part of the nerve between the chorda tympani and the geniculate ganglion. The signs are as before, with the exception that there is also a loss of taste in the anterior two-thirds of the tongue and a slight diminution of salivation if the

lesion is below the branch of the nerve to the stapedius muscle. If proximal to the latter, there is phonophobia, a term suggested by the author as more appropriate than hyperesthesia acoustica or others which have been used.

3. Transgeniculate—the area occupied by the geniculate ganglion including the branching of the greater superficial petrosal nerve. The signs are as before except that hyperlacrimation is replaced by hypolacrimation or even the absence of lacrimation on the affected side. The uvula and soft palate deviate to the good side.

4. Suprageniculate—the part of the nerve above the branching of the greater superficial petrosal nerve. The signs are as in the preceding divisions, but *without* loss of taste in the anterior two-thirds of the tongue as the taste fibers passing off in the greater superficial petrosal nerve escape the lesion. This fact has been noted by several other authors.

Two cases of herpes with facial palsy are then presented and analyzed with respect to the location of the lesion in terms of the given subdivisions.

When the entire syndrome is thus examined, it seems evident that it cannot be well explained by

Hunt's theory. However, the cases presented here and others culled from the literature fall into the author's classification very well.

Since both patients recovered, the classification could not be subjected to the final test of pathological examination.

The author would restrict the use of the term "Ramsay Hunt's syndrome" to those cases in which the geniculate ganglion actually is involved, that is, the herpes oticus syndrome. The cases of herpes facialis and herpes of the occipitocollar region, he feels, should be classified separately.

ROBERT E. GREEN, M.D.

Fincher, E. F.: Craniotomy and Total Dissection as a Method in the Treatment of Abscess of the Brain. *Ann. Surg.*, 1946, 123: 789.

In the mass of somewhat confusing literature on the treatment of brain abscess, with the wide divergency of opinions regarding the proper management of such lesions, this article stands out with distinction because of its clarity and instructiveness. The author has used his 5 illustrative case histories with strong effect to demonstrate various lesions and the

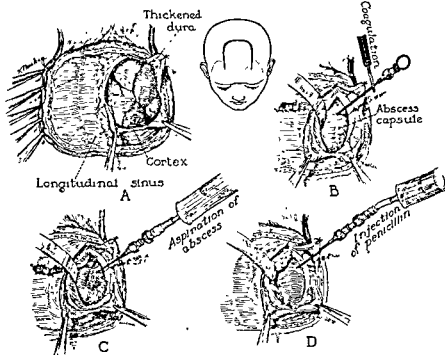


Fig. 1.—A. When the cortex has been exposed the depth of the abscess is determined by the exploratory ventricular needle.

B. The overlying cortex may be transected or a circumcisional uncapping performed to give an adequate exposure of the dome of the abscess. The exposed cortex and medullary brain are protected with cottonoid strips soaked in penicillin. The abscess is punctured under electrocoagulation.

C. Syringe aspiration of the cavity for gaining space for capsule dissection and for specimen collection minimizes wound contamination as compared with open suction methods.

D. The total amount of penicillin solution injected is far less than the volume of pus aspirated. The needle is withdrawn under electrocoagulation.

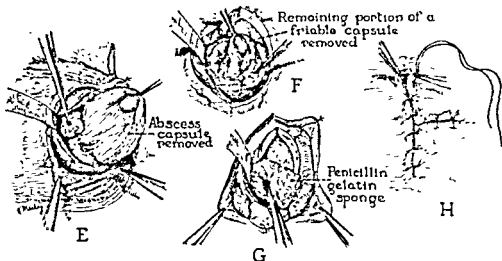


Fig. 1.—E. The small opening made by the aspirating needle is closed with the cupped forceps and, if possible, this traction-hold is maintained throughout the capsular dissection.

F. The friability of the abscess wall or the size of the lesion may necessitate piecemeal dissection. This is accomplished best with cotton pledget dissection, the abscess wall being folded into its own cavity.

G. Gelatin sponge strips soaked in thrombin and then penicillin are placed in the medullary cavity. They are useful in sealing an opening into the ventricle cavity should such an accident occur in the dissection.

H. The dura is sutured tightly as in routine craniotomy following removal of a tumor. (Courtesy of J. B. Lippincott Co.)

ingenuity with which he has met various problems. Fincher recognizes the great advantage in being able to dissect out a firmly encapsulated abscess *in toto*, much like a tumor mass, as do many other surgeons, but he points out that when this is not possible he has carried out radical total dissection of the entire mass and of any suspicious contiguous tissue, aided by heavy but well controlled doses of sulfa drugs and penicillin, with a surprisingly low postoperative morbidity and as yet no mortality. It may be necessary, as a temporizing procedure, first to tap the abscess to relieve any severe and increasing intracranial tension, especially if time for removal of the causative focus must be taken. He makes the point, too, that the primary focus (osteomyelitic bone, a petrosal abscess, a mastoid infection) must be removed before or at the time of definitive attack on the intracranial abscess, else no cure of the abscess may be expected. Following a preliminary tapping of an abscess he has used thorium dioxide to outline the extent of the abscess cavity, and in at least 1 case this procedure led to the discovery of an unsuspected multilobular abscess which was later completely and successfully removed.

Figure 1 illustrates quite well most of the technical steps in his treatment of brain abscess. Ventriculography is frequently used for accurate localization of the lesion. A craniotomy or osteoplastic flap is then performed, the dura mater opened, the wound packed with penicillin-soaked cotton strips, the depth of the abscess estimated by the ventricular needle, a minimal cortical excision made, and then, with the coagulating electric current, the exposed

capsule is prepared for aspiration. Through the one needle the pus is aspirated and the penicillin solution is injected, following which the somewhat collapsed capsule is gently teased out of place with soft cotton pledgets. The closure is the same as that for any clean craniotomy, with tight closure of the dura mater, galea, and skin, without drainage. Penicillin or sulfa drugs may be left in the intracranial portion of the wound.

JOHN MARTIN, M.D.

### SPINAL CORD AND ITS COVERINGS

White, J. C., and Peterson, T. H.: Lumbar Herniations of Intervertebral Discs; Value of Surgical Removal for Naval Personnel. *Occup. Med.*, 1946, 1: 145.

In a series of 947 civilian cases of herniated intervertebral disc treated by operation, by various workers, about 68 per cent of the patients were rendered completely or nearly free of symptoms, and they were able to do their former work; 17 per cent were able to carry on in a more limited capacity, and 15 per cent were not benefited.

Since 1940, few articles dealing with the results on service personnel were written, and most of these did not include long follow-ups. However, in both the United States and the British military services, the trend has been toward conservative treatment because it was observed that operations were not successful in getting a large percentage of men back to full duty.

In the present series, 39 cases which were operated upon for the removal of a herniated disc are pre-



sented. All of the patients had severe low back pain and sciatica which failed to respond to a month's trial of conservative orthopedic therapy. All but 2 of this group showed a definite filling defect on the pantopaque spinogram; 101 patients with syndromes suggesting lumbar disc herniation were examined by myelography. In the absence of a clear cut projection or root filling defect, 56 were returned to the orthopedic service for conservative treatment. The 2 patients upon whom an exploratory operation was performed after normal spinograms were obtained, had symptoms and signs of root compression, and an elevated spinal fluid protein. In both cases definite disc herniation was found.

In the group subjected to operation, it was obvious that if the pain was not relieved, all would have to be discharged from the service.

Twenty-four men had follow-ups to the end of 1944 (from 5 months to 2½ years after operation). Of this group, 13 (54.2 per cent) had excellent results, these were service men on active duty or veterans on unlimited activity. Five patients (20.8 per cent) had good results, these were service men on limited duty, but ready for full duty, or veterans engaged in moderately active work. Five patients (20.8 per cent) had uncertain results, these were still on limited duty, and presented recurrent back ache or sciatica. In 1 patient the result was a failure, and the patient was discharged from the service on account of weakness in his back.

In the remaining 15 cases, only the disposition at the time of discharge from the hospital was known. Three (20.0 per cent) were returned to active duty, 10 (66.7 per cent) were returned to light duty or transferred to a convalescent hospital with a good chance of return to full duty; and 2 (13.3 per cent) were transferred to a convalescent hospital with a poor chance of return to duty.

Four of the group had multiple ruptures of the intervertebral discs. At least 3 of these had excellent operative results.

Three patients had recurrent pain due to rupture of another disc and 4 others had later disability after an initially successful result. One of the latter was noted to have loose articular facets at the time of operation.

In addition, exploratory operations were performed on 7 other cases, but the diagnosis of herniated disc was not substantiated at that time.

In general, it is believed that spinal fusion should not be done unless structural defects in the vertebral column are obvious. When spinal fusion is done, a much longer period of hospitalization is required, which always results in a loss of desire to return to active service.

It is most important for doctors and nurses to impress upon these patients that they have not had a serious operation, because it is easy for this group of patients to magnify postoperative complaints, and thus become eligible for pension.

It must be emphasized that in service hospitals, surgical removal of protrusions of intervertebral

discs should be performed only in clear cut cases, and on patients who are otherwise in sound physical condition and eager to return to their military duties.

ROBERT E. GREEN, M.D.

Friberg, S., and Hirsch, C.: On Late Results of Operative Treatment for Intervertebral Disc Prolapses in the Lumbar Region. *Acta chirurg. scand.*, 1946, 93: 161.

The authors report the results of check-up examinations done 5 years after the surgical removal of prolapsed lumbar intervertebral discs in a series of 44 patients. Forty-two of these patients were working; 32 had returned to their former profession which was physical labor in 22 cases. The average convalescence before they returned to work was 20 weeks. After 5 years, 83.8 per cent of the patients were free from sciatic pain and 70 per cent were free from low back pain; 65 per cent showed normal mobility of the lumbar region. The Achilles reflex was still absent in every patient, and more than half of them still had areas of hypalgesia. In none of the cases did the authors, who are orthopedic surgeons at the University of Stockholm, perform a fusion, and they do not recommend a combined operation. However, a fusion may be considered at a later date if the low back pain has not subsided.

All of the patients were first treated conservatively and all had preoperative myelographic studies. The authors do not consider a case of longstanding lumbago or sciatic pain with an unstable low back as being fully investigated without myelography, and they make a definite differentiation between a prolapsed intervertebral disc and degeneration of the disc without prolapse.

GEORGE PERRET, M.D.

Livingston, W. K., and Newman, H. W.: Spinal Cord "Concussion" in War Wounds. *West J. Surg.*, 1946, 54: 131.

In a study of 821 cases of major nerve injury resulting from bullets or shell fragments, the authors noted a transient quadriplegia in 33, or 4 per cent of the cases. There was no evidence of direct damage to the central nervous system in any of the cases. The transient nature of the disturbance suggests that it is comparable to concussion of the cerebrum; hence the cases are presented as spinal cord concussion.

Several case reports are presented. The usual features were a retention of consciousness, a sudden complete loss of voluntary control and of sensory perception of the extremities, and a rapid return of normal function of the extremities not directly injured.

Several postulations as to the causative factors are discussed. The possibility of a massive afferent impulse bombardment of the spinal centers is presented. However, the occurrence of a transient quadriplegia without major nerve involvement, and its absence in many patients with nerve injury at a distance from the spinal axis, suggests that this hypothesis cannot be accepted. The authors believe

that a dyssynchronization of neural activity results from the massive stimulation by the trauma. Whether the trauma is to the spinal cord, its meninges, or nerves is not known. JACK I. WOOLF, M.D.

Hagelstam, L.: On the Deformities of the Spine in Multiple Neurofibromatosis (von Recklinghausen). *Arch. chir. scand.*, 1946, 93: 169.

After a general review of the literature on multiple neurofibromatosis and the skeletal changes associated with it, the author analyzed a series of 105 cases of deformities of the spinal column collected from the literature. The most common of them were kyphoscoliosis, scoliosis, and kyphosis with occasional gibbus formation in the thoracic and dorsolumbar regions. To these, the author added a case in which he found a marked dorsolumbar kyphoscoliosis with an hourglass shaped deformity of the first, second, and third lumbar vertebrae. He thought this deformity to be the result of a tropho-neurotic growth disturbance secondary to the neuro-fibromatosis. GEORGE PERRET, M.D.

### PERIPHERAL NERVES

Björkstén, G. af: Position of the Fingers and Function Deficiency in Ulnar Paralysis. *Acta. chir. scand.*, 1946, 93: 99.

The author analyzed the anomalies in the position of the fingers in 152 cases of ulnar nerve lesions treated at the Finnish Red Cross Hospital in 1944 and 1945. The lesion was above the elbow in 87 cases and below the elbow in 65 cases and produced various degrees of clawing of the fingers. He found no clawing in 7 per cent, clawing of the fifth finger alone in 10 per cent, of the fourth and fifth fingers in 41 per cent, of the third, fourth, and fifth fingers in 18 per cent and of the second, third, fourth, and fifth fingers in 24 per cent of the cases.

He deduced that the lumbrical muscles responsible for the deformities were innervated by the ulnar nerve and showed considerable variations in their innervation. He reported poor functional results of the small hand muscles after ulnar nerve suture and ascribed them to a degeneration of the muscles partly caused by the hyperextension of the paralyzed lumbricals. A splint of the clasp type applied across the hand over the metacarpophalangeal joints enabled the patients to extend their fingers, relieved the clawing, and increased the functional results. GEORGE PERRET, M.D.

### SYMPATHETIC NERVES

FitzGerald, P. A.: Sympathectomy for Hypertension. *Irish J. M. Sc.*, 1946, ser. 6, 109.

From a general review of the literature, the author concludes that essential hypertension accounts for 90 per cent of all cases of elevated blood pressure. A summary of 21 personally observed cases is presented. It is believed, from the work of Goldblatt (on renal ischemia), Page and others (on renin), and

Homer Smith (on renal blood flow) that man has both a neurogenic and a hormonal control over renal blood flow. "... one must conclude that essential hypertension is nervous in origin, and only involves the kidney at a comparatively late stage." Such a judgment directs sympathectomy as a treatment for this condition. Factors produced by sympathectomy which are important in the reduction of hypertension are increased renal blood flow, stabilization of the reflex vasomotor mechanisms in peripheral vessels, and reduction in the amount of adrenalin which enters the circulation.

Patients for whom a sympathectomy is considered must have essential hypertension and not hyperpiesia secondary to endocrine disorders, nephritis, or aortic coarctation. The kidneys and the heart should be well compensated and the most favorable age group is below 40 years. Of value in assessing the status of the individual and indicating the prognosis after operation are ophthalmoscopic examination of the retinal vessels, renal function tests, and pressure changes during sedation. Eye signs are not reliable guides for individual prognosis although people with slight arteriolar constriction and/or minimal vessel crossing changes give better operative results. Reduction of renal function below a Conway figure of 50 carries a bad prognosis, but in the absence of renal necrosis or nitrogen retention, kidney function is considered irrelevant. When the diastolic pressure is more than 140 operation is useless as a means of pressure reduction, but many symptoms are ameliorated. The prognosis seems worst in a combination of high pulse and high diastolic pressure. Best results are with a pulse pressure which is less than half of the diastolic. When a fall in blood pressure to normal occurs after sodium amytal sedation, a sympathectomy is likely to help considerably.

Other tests used are the cold pressor test of Hines and Brown, the variation in pressure from bed rest to exercise, and the change from hyperventilation to apnea. The more labile the blood pressure, the better the expectation following operation. Even when these tests do not indicate a good operative result, occasionally sympathectomy causes an unusually good response. This is true more frequently in the acute than in the chronic cases of hypertension. Often subjective symptoms such as headache, palpitations, and dizziness are significantly improved following operation so that blood pressure levels cannot be the sole criteria of success or failure.

Many variations of operations have been described to denervate the kidney, adrenal region, and to promote peripheral vascular relaxation, viz.

- 1923 Suggested first by Kraus to Bruening
- 1923 Discussed further by Danielopolu
- 1930 First performed. Unilateral splanchnicectomy. Pieri
- 1934 Anterior root section. Adson and Brown
- 1934 Subdiaphragmatic splanchnic exposure. Craig; later Adson
- 1935 Supradiaphragmatic splanchnic exposure. Peet

1936 Celiac sympathectomy. Crile

1937 Total sympathectomy. Grimson

1940 Lumbodorsal sympathectomy. Smithwick

The surgical treatment of hypertension grew slowly in the minds of European workers and achieved final practical significance by surgeons in the United States. The operation most commonly utilized at present is that proposed by Smithwick. The author suggests the following revisions of Smithwick's classic procedure as described in 1940. The patient is placed in a lateral position and tilted 45° toward the operator. This avoids the cardiovascular strain imposed by the prone position and visualizes well the sympathetic chain. Instead of dissecting all the nerve trunks downward, he advises pulling the sympathetic nerves forward and working up the chain, but dissects down the splanchnic nerves. This is in accordance with the anatomical relation of the sympathetic nerves and intercostal vessels.

The side effects of the lumbodorsal sympathectomy are trivial for the most part. In the order of decreasing frequency they are: vascular hyperemia of the lower limbs which become permanently warm and dry. Rarely the hands become cold as though they were the site of sympathetic hypertonus. Postural hypotension frequently occurs, but soon disappears within 2 to 3 months. Bandaging the legs or wearing an abdominal binder alleviates this somewhat. Some believe that bilateral section of the first lumbar ganglion interferes with ejaculation, but not potency, in the male. In the female the pain of menstruation and of the first stage of labor disappears. Increased intestinal peristalsis may occur especially in elderly people. This is easily controlled by atropine and disappears spontaneously in a few weeks.

The author has performed 16 sympathectomies of the lumbodorsal type in 9 patients, removing the sympathetic chain from the ninth dorsal to the second lumbar, as well as the splanchnic nerves. He waits 2 weeks before doing the second stage. He obtained 2 excellent, 4 very satisfactory results, and 1 poor result in a period as long as 2½ years. (The

other patients are awaiting the second stage of the operation). He has had no operative mortality. In 8 other instances he considered patients unsuitable for operation. Of these, 6 died within 4 months after this conclusion. He believes sympathectomy is the best method in use at present for the treatment of essential hypertension.

C. FREDERICK KITTLF, M.D.

## MISCELLANEOUS

Florini, E.: Bilateral Cervical Ribs Which Became Manifest after Trauma of the Hands (Costa cervicale bilaterale resa manifesta da un trauma alle mani). *Arch. ital. chir.*, 1944, 66: 180.

A 22 year old patient developed an indolent ulcer on the dorsum of the right hand following a burn with nitric acid. The roentgenographic examination revealed a bilateral hypertrophy of the transverse processes of the seventh cervical vertebra.

A partial resection of the right transverse process of the seventh cervical vertebra, combined with a section of the corresponding scalenus muscle and subclavian sympathectomy caused the disappearance of the syndrome of pallor, perspiration, dystrophy of the nails, and tactile and thermic hypesthesia.

Eight months later the patient developed a similar condition on the left hand following an injury. A similar procedure was employed as on the right side and in addition to it a fibrous band uniting the cervical rib with the first thoracic rib was severed. The patient recovered. A trauma of the hands may activate a latent syndrome of a cervical rib. This observation is important from the medicolegal point of view.

A fibrous band uniting the cervical with the first thoracic rib deserves attention as it may be responsible for a great part of the symptoms. If the connective tissue is found to be edematous or in a stage of proliferation, its removal should supplement the anterior scalenotomy and the perisubclavian sympathectomy.

JOSEPH K. NARAT, M.D.

# SURGERY OF THE THORAX

## CHEST WALL AND BREAST

Leucutia, T.: The Value of Orchidectomy in the Treatment of Carcinoma of the Male Breast. *Radiology*, 1946, 46: 441.

If the estrogenic origin of mammary carcinoma in the human being is accepted, it is reasonable to expect that some of the observations made in animal experiments should hold for both men and women.

In mammary carcinoma of the female, surgical or roentgen castration has been applied periodically for nearly half a century, and the conclusions as to its value are still far from definite.

From the literature it may be seen that:

1. In the presence of osseous metastases, roentgen castration is beneficial in one-third of the cases of mammary carcinoma, producing symptomatic relief and perhaps some prolongation of life.

2. In local recurrences and generalized visceral metastases, roentgen castration is of no particular value, although sporadic favorable results are described in the literature.

3. In the operable group of mammary carcinomas, routine roentgen castration is considered a futile effort, having no influence on the final results. More recently, considerable benefit is being claimed from surgical castration (bilateral oophorectomy) in the premenopausal stage, but the number of cases published is still too small to warrant final conclusions.

In mammary carcinoma of the male, castration, which is best accomplished by bilateral orchidectomy, has been done, but it is not surprising that the conclusions as to its value should be indefinite.

Leucutia presents 2 cases of carcinoma of the male breast, in which, at a very advanced stage, orchidectomy was performed as a therapeutic measure. In the first case radical mastectomy and repeated series of deep roentgen therapy led to a satisfactory result for 9 years, when general osseous metastases developed. Within a few weeks following a bilateral orchidectomy there was a spectacular improvement, and the metastases completely disappeared in a period of 2 months. At the present time, nearly 2 years later, the patient is in good condition and apparently free of carcinoma.

In the second case a radical mastectomy followed by four series of deep roentgen therapy failed to prevent the development of local recurrence, which assumed the character of cancer en cuirasse. There were also signs of beginning metastases in the liver, but there was no invasion of the osseous system. Two years later, a bilateral orchidectomy was done. There was a very remarkable improvement, with a 20 lb. weight gain within a few months after the operation. However, 6 months after the operation, extensive local recurrence developed as well as widespread visceral metastases and the patient expired 2 months later.

The reason why osseous metastases from mammary carcinoma of both sexes respond more readily than local recurrences or visceral metastases to the castration treatment, particularly in appropriate association with other methods of therapy, is not clear. It is possible that a neoplasm which, despite everything, produces local recurrence or swiftly invades distant viscera, represents a cancer of extremely great activity from the beginning and the removal of the estrogen source would have little or no influence on it. On the other hand, metastases to the osseous system are known to occur at a somewhat later period, which suggests a slower rate of growth of the cancer. Moreover, the osseous system itself does not possess a function as vital for the survival of the body as, for example, the liver, brain, and most other viscera, a fact which, in the end, results in an apparently additional prolongation of life.

STEPHEN A. ZIFMAN, M.D.

## TRACHEA, LUNGS, AND PLEURA

Maurer, E., and Blades, B.: Hernia of the Lung. *J. Thorac. Surg.*, 1946, 15: 77.

True hernia of the lung is a protrusion of the pleural covered lung beyond its normal boundaries, through an abnormal opening in the thoracic enclosure.

According to location, lung hernias may be classified into three groups:

1. *Cervical.* These usually occur through the superior aperture of the thorax, in the interval between the sternocleidomastoid and scalenus anticus muscles, following some deficiency in Sibson's fascia, and are usually congenital.

2. *Thoracic.* These are most common because trauma is so common in this region. Herniation usually occurs anteriorly because the congenitally weak area, near the sternum, is covered only by the pectoral muscles, which do not give the support given by the trapezius, latissimus dorsi, and rhomboid muscles posteriorly.

3. *Diaphragmatic.* The extreme rarity of diaphragmatic hernia is probably due to the imbalance between the positive intra-abdominal and the negative intrathoracic pressures so that, in injuries of the diaphragm, the abdominal viscera usually are displaced into the corresponding hemithorax, while the lung collapses.

According to etiology, lung hernias may be classified into two groups:

1. *Congenital.* These occur most commonly in the superior thoracic aperture, or anteriorly in the inter-spaces near the sternum.

2. *Acquired.* These are traumatic, spontaneous (as a result of local weakness in the boundaries of the thoracic cavity, with an abnormal increase in intrathoracic pressure), or pathologic (after abscesses of

the chest wall, empyema necessitatis, tumors, and tuberculous caries of the ribs).

As a rule, pulmonary hernias present few symptoms, especially if nontraumatic. The first complaint is tenderness over a new swelling in the chest, which increases in size on forced expiration. In the acute traumatic or postoperative varieties, however, the picture is obscured by severe symptoms secondary to injury of the chest wall or pleura. The presence of a palpable orifice in the thorax, through which a smooth, soft, crepitant, reducible mass appears on forced expiration, makes the diagnosis evident. Should the mass appear on inspiration and disappear on expiration, prolapse of the abdominal viscera into the thorax should be suspected.

In differential diagnosis, the following conditions should be considered: subcutaneous emphysema, empyema necessitatis, lung suppuration and degenerating malignancy breaking through the chest wall, tumor of the thoracic wall, tuberculous caries of a rib, and gas bacillus infection of the thorax or chest wall with crepitation.

The treatment is essentially surgical. Any defect of the chest wall can usually be repaired by plastic procedures involving only structures which are part of the chest wall—rib, periosteum, and muscle. The most important feature in the repair of pulmonary hernias is the covering of the defect with sturdy bone, or with periosteum which will produce bone. The most satisfactory repair of average size defects is obtained by the suturing of periosteal flaps developed from ribs immediately above and below the margins of the hernial orifice. The freeing of adhesions and of the lung about the margins of the hernial orifice, combined with the creation of a local pneumothorax, is important in producing a cushion between the lung and the freshly repaired chest wall. Endotracheal administration of the anesthetic agent is necessary, since this insures safety when the pleura is opened widely, and makes it possible to leave the lung in the desired degree of inflation.

SAMUEL KARN, M.D.

Nylander, P. E. A., and Kivikanervo, K.: On Extrapleural Pneumolysis in Pulmonary Tuberculosis. *Acta chir. scand.*, 1946, 93: 325.

Investigations of extrapleural pneumolysis are too often based on limited materials and short observations. This is a continuous series of 118 cases of pneumolysis in 115 patients observed between 1939 and 1944; 47 were men and 68 women, the youngest being 13 years old and the oldest 50. The authors' opinion regarding the nature of the cases in which pneumolysis should be applied, which is based on the successful results as well as the failures at the sanatorium Kiljavanummen Parantola, is reported.

At the end of the observation period 91 patients survived, 67 without bacilli. Twenty-four patients had positive sputum and most of these were unable to work. The earliest death took place 3 months after the operation. Treatment was often given in cases in which no other collapse therapy was possi-

ble. Bilateral collapse treatment offers excellent selectivity.

Productive forms of disease in which the general condition has been improved as much as possible are most suitable. In approximately every third case of the exudative type, tuberculous infection arises in the extrapleural space, and from 10 to 15 per cent of these cases develop specific empyema cavities which often heal at the cost of collapse; yet this hazard is less than that of disseminations and pneumonias occurring in thoracoplasty with exudative disease.

In old cases the tissue overlying the cavity may derive some of its blood supply through the endothoracic fascia. Separation of the parietal pleura may interfere with the blood supply with rupture of the cavity by necrosis. When the patient is known to have had a serious pleural affection, pneumolysis must be considered contraindicated. The difficulties in establishing a collapse increase the further down the cavity is located, but because the thorax remains practically intact, pneumolysis may be used when the function of the circulatory system is no longer quite normal in individuals of more advanced age. Results have been better in women than in men.

Under local anesthesia with the patient in the sitting posture an oblique incision is made at the apex of the shoulder blade at the second or third thoracic vertebra. A length from 6 to 8 cm. is removed subperiosteally from the fourth or fifth rib. Strict asepsis and meticulous hemostasis are important.

The lung is left unstripped some distance above the hilus in order that the cavity may be compressed against the mediastinum and will not drop to the floor of the space where there is no fixed base.

The first group of complications includes large postoperative hemorrhages, nonspecific infections, and the formation of exudate. The second group comprises specific infections and perforations of the lung. Collapse created by means of pneumolysis has been completed either by thoracoplasty or by phrenic exeresis in 12.2 per cent of the author's cases on account of obliteration of the space. An additional pneumolysis is indicated when coagulation makes obliteration evident. It should be done about a fortnight after the first operation when clot is still removable and specific infections have not yet arisen to develop into severe extrapleural empyemas.

In cases in which a sterile exudate persists pneumothorax must promptly be converted into oleothorax. For empyemas the authors use gomenol-paraffin oil alone or with azochloramid rinses. For the most dangerous complication, bronchial fistulas, there is no reliable remedy.

Four weeks are allowed for drying up and healing of the space for converting pneumothorax to oleothorax. Initial air refills with slightly negative pressure are generally followed by oil. In a few pneumothorax cases the lung re-expanded normally, as it may also do with oil. In most of the cases oil has remained for years in the extrapleural space without deleterious effect.

LYNN JOHNSON, M.D.

Santy, P., Bérard, M., and Fraisse, P.: Surgical Treatment of Abscess of the Middle Lobe of the Right Lung (Le traitement chirurgical des abcès du lobe moyen du poumon droit). *Lyon chir.*, 1945, 40: 179.

Among 120 lung abscesses the authors encountered 6 located in the middle lobe on the right side. Such location creates 2 problems—diagnosis and surgical approach.

As judged from published observations, signs of an abscess in the middle lobe are not dramatic. Purulent expectoration, sometimes fetid, is not abundant and elevations of the temperature are not very marked. Hemoptysis, frequently recorded in the evolution of such abscesses, may lead to a diagnostic error, suggesting a neoplasm or tuberculosis rather than an abscess. The ventilation of the lobe depends entirely on 2 axial bronchi and may be suppressed easily by suppurative processes. Such functional obliteration of the bronchi renders the evacuation of the abscess difficult. Vomiting is rare and the roentgenograms seldom visualize fluid and air because evacuation of the cavity is difficult. The inflammatory reaction and congestion of the bronchial mucosa are responsible for the relative frequency of slight hemoptysis. The obliteration of the bronchi causes atelectasis, which is frequently visible in roentgenograms. However, the interpretation of the films is not always easy, especially if they are taken only in the anteroposterior direction, but the opaque triangle visible in pictures taken in the lateral direction is quite characteristic. Tomography is a valuable diagnostic aid. Frequently only bronchoscopy and bronchography lead to the correct diagnosis. Instead of a direct injection of lipiodol through a bronchial catheter the authors use tracheal instillation.

The authors discuss the anatomic topography of the middle lobe, paying particular attention to the interlobar incisures which interfere with the creation of a pleural symphysis. Pneumotomy of the right middle lobe always carries the risk of operative pneumothorax. Only operations on certain limited zones of the upper and lower lobes carry a similar risk.

The authors describe the variable character of the lesser incisura. Coalescence of the upper and middle lobes creates a great handicap for exeresis because a simple dissection in such cases is unable to liberate the middle lobe up to its pedicle.

Repeated punctures may be necessary to locate an abscess in the middle lobe because tomographic studies may visualize the lesion without establishing its exact relations to the thoracic wall. The best approach is from the front. Pneumotomy through the axillary line invariably exposes one of the incisuras. As a rule, the best approach is through the fourth or fifth intercostal space anteriorly. A resection of the fifth rib is usually sufficient but occasionally the fourth and sixth ribs must also be removed. Not more than from 4 to 5 cm. of a rib should be removed. The authors advocate two stages of pneu-

motomy with an interval of from 8 to 10 days between them. Even if the aspiration revealed an abscess, there is always the danger of surgical pneumothorax caused by the exposure of an incisura. If a pneumothorax is established before the discovery of the abscess, the danger of an infection of the pleura is relatively small. In such cases the pneumothorax should be aspirated and an attempt should be made to close the opening in the pleura. If the pleural cavity is opened at the time of the discovery of the abscess, the opening in the pleura should be promptly closed and proper drainage of the pulmonary focus should be established to avoid an infection of the pleural cavity.

In 4 of 5 cases of pneumotomy an operative pneumothorax was inadvertently established by the author by exposure of one of the incisuras. Attempts to provoke an interlobar symphysis by the insufflation of sterile talcum powder failed.

A surgical intervention is indicated only if one is dealing with a grave form of suppuration, without hope of a favorable spontaneous evolution. Sometimes direct aspiration through the bronchoscope and the application of cocaine to the bronchial mucosa may ameliorate the condition by facilitating drainage.

The authors' experience with lobectomy in the treatment of bronchiectasis showed that such a procedure is advisable only after the lesions became relatively dry. This can be accomplished by postural drainage in bronchiectasis but not in the case of an abscess, and therefore the authors prefer pneumotomy to lobectomy as far as the treatment of abscess is concerned. Furthermore, lobectomy of the middle lobe is technically much more difficult than lobectomy of the lower lobe because the separation from the upper lobe may be laborious and hemostasis of the pedicle may require a sacrifice of the lower lobe. Therefore, the authors recommend lobectomy only for chronic abscesses with pyosclerosis and associated bronchiectasis. Lobectomy may also be indicated if the process does not cease after pneumotomy and the suppuration and hemoptysis persist.

The authors employed pneumotomy in 4 cases, a single tamponade in 1 case and pneumotomy followed by lobectomy also in 1 case. One of the patients is still under treatment while the 5 others made complete recovery. JOSEPH K. NARAT, M.D.

Bérard, M., Galy, P., and Dumarest, J.: The Secondary Epithelization of Cavities of Chronic Lung Abscesses, (L'épithélialisation secondaire des cavités d'abcès chroniques du poumon). *Presse méd.*, 1946, 54: 234.

In the surgical treatment of certain pulmonary suppurations, one of the major difficulties is represented by the absence of closure of the drained cavity, in spite of the disappearance of the local phenomena of suppuration.

The rigidity of the pulmonary parenchyma around the cavity, appreciable at the time of intervention



Fig. 1. Section of the wall. On the surface cylindrical epithelium is found lying on a slightly vascular fibrous tissue. Subepithelial cellular infiltration.

is considered the chief cause of persistence of the cavity.

The study of the inner lining of the walls, showing at times an epithelial border of the bronchial type, led the authors to a different interpretation of the facts. This inner wall—smooth and glistening like mother-of-pearl—is in contrast to the broken and irregular lining of the acute abscess cavity.

The shiny appearance of this inner lining of the drained cavity brought up the question in the authors' minds as to whether the original condition was a true abscess—a newly formed cavity in the course of suppuration in tissue which was formerly healthy—or the suppuration of a pre-existing cavity in the form of a congenital cyst or bronchiectasis. Diagnosis is often difficult even after microscopic examination of specimens of the wall removed at biopsy.

The presence of an epithelial covering of the bronchial type on the inner surface of the cavity is considered an important finding in favor of cyst.

The authors report some observations after microscopic study of tissue of the wall of a persistent cavity removed at biopsy 2 years after pneumotomy. At the time of pneumotomy it was noted, expressly, that the cavity contained pulmonary scarring, a sign of abscess of the lung. The contents of the most infected cyst are always liquid; the lining of the wall does not show scarring.

From the accompanying photomicrograph it can be seen that in one extremity of the section there is pseudostratified, ciliated epithelium. The epithelium lies on a distinct, well marked base of dense connective tissue with longitudinal bundles and little cellular infiltration. The capillary vessels are few in number. At the other extremity of the section, the fibrous tissue is more vascular. There are visible certain alveolar elements in the form of small cystic formations and a bronchus of fair size, lined by normal epithelium with much infiltration of the corium. Muscular elements are dissociated.

Similar observations were made by the authors while studying histological sections of the wall of a persistent cavity known to be due to suppuration of a pre-existing congenital cyst.

Theoretically, the wall of an epithelized chronic abscess does not contain smooth muscle, and glandular and cartilaginous structures of the bronchial type. In the congenital cysts and the bronchiectatic cavities, on the contrary, such structures will be found to be more or less numerous. The authors agree that these differences have great differentiating value, but are not absolute.

The mechanism of the epithelization of the chronic abscess cavity seems to the authors to be due to an epithelial growth which leaves the bronchus in drainage and advances progressively in the sticky pocket to cover the wall of the cavity. This epithelization is the most important factor in the passage to chronicity of the abscess cavity after pneumotomy.

From a therapeutic view it seems logical to attempt destruction of this epithelium. Such attempts run into great technical difficulties. The surgical decortication of the lining of the cavity exposes the patient to the danger of gaseous emboli by the entrance of air into newly formed capillaries in the wall. Chemical cauterization is possible, but has not been tried by the authors. Secondary lobectomy is indicated.

Early care of the foci of beginning pulmonary suppuration is the best prophylaxis of this formidable complication.

In résumé, the cavities of chronic abscess of the lung are often difficult to distinguish, both clinically and roentgenologically, from congenital cysts which have been secondarily infected and drained by pneumotomy. It is customary to consider that the histological examination of the lining of the wall permits a distinction between the lesions, as only the congenital cysts should present an epithelium of the bronchial type. Examination of the lining of the walls of certain pulmonary cavities, drained for a long time, allowed the authors to discover an epithelium on the surface in some of their cases in which the acute character of the initial lesion could not be doubted. So, an abscess cavity having passed to chronicity can secondarily epithelize itself. This is of importance in explaining the absence of closure and the cicatrization of some cavities after drainage.

BLACKWELL MARKHAM, M.D.

Watts, C. F., Clagett, O. T., and McDonald, J. R.: Lipoma of the Bronchus; Discussion of Benign Neoplasms and Report of a Case of Endobronchial Lipoma. *J. Thorac. Surg.*, 1946, 15: 132.

Because of the frequent presence of fat in tumors of the bronchus it was decided to study human bronchi in an attempt to answer three questions: (1) Is fat a normal component of the bronchus? (2) If it is, in what portion of the bronchial wall does fat occur? and (3) In which of the bronchi is fat present?

Blocks of tissue were cut from the bronchi and uninvolved parenchyma of 15 lungs that had been surgically removed from patients who had bronchogenic carcinoma. In addition, routine sections stained with hematoxylin and eosin, from the lungs

of 25 patients who died of brain tumors, were examined.

In the large bronchi fat always was present in the fibrous tissue external to the cartilage plates. Lesser amounts were found with equal frequency in the connective tissue (submucosa) between the cartilage and the muscular layer. In the latter position, fat was most frequently found near the cartilage plates; less often it approached the muscular layer. In the smaller bronchi fat was usually present in the walls in gradually decreasing amounts until the cartilages disappeared. The authors were unable to find fat in any portion of the bronchial tree which did not contain cartilage.

The treatment of fibromas, chondromas, hamartomas, and lipomas is the same. The procedure of choice is removal with bronchoscopic forceps, surgical diathermy, and local implantation of radon seeds, if necessary. Removal of pulmonary tissue need be done only when the tumor cannot be successfully treated through the bronchoscope or when suppuration in the pulmonary tissue distal to the tumor endangers the health of the patient. On the other hand, there is much disagreement concerning the proper treatment of the adenoma-cylindroma group. Those who consider these tumors strictly benign treat them just as they would the other benign tumors mentioned previously in this report. Others believe that the danger of local invasion, metastasis, hemorrhage, and local recurrence with bronchial occlusion outweighs the risk of primary pneumonectomy or lobectomy.

The authors' attitude toward the treatment of bronchial adenomas has been well summarized in a recent article by McDonald, Moersch, and Tinney. In brief, they favor conservative treatment when the adenoma is attached by a narrow pedicle and is movable, when it is situated close to the coryna, and when the general condition of the patient is poor. Lobectomy or pneumonectomy is preferred when the adenoma is situated in a bronchus that cannot be visualized bronchoscopically, when severe secondary pulmonary suppurative disease is present, when there is obvious evidence of peribronchial infiltration (of the adenoma), and when the adenoma has been treated endoscopically and tends to recur. Cylindromas are being treated in a similar manner until more is known about their growth potentialities. The authors are aware of the advantages of surgical extirpation and are now employing this method with increasing frequency.

Herbut, P. A., and Clerf, L. H.: Bronchogenic Carcinoma. *J. Am. M. Ass.*, 1946, 130: 1006.

The method of examination of bronchial secretions for cancer cells is presented not with the idea of finding a substitute for the already well established and highly efficient methods used in the diagnosis of pulmonary carcinoma, but as an adjunct to be used in conjunction with these methods. By the method outlined it is hoped that the central, peripheral, or pulmonary neoplasms will be diagnosed at the time

of the first bronchoscopy without losing a valuable month or two waiting for an x-ray shadow to increase or decrease in intensity in order to be certain that a lesion is or is not neoplastic. By that time it might be too late.

In cases in which a tumor was visualized endoscopically it was made certain that the neoplasm was not traumatized with the bronchoscope, in order that only spontaneously sloughed material might be examined.

The aspirator was washed with a small quantity of saline solution only when the amount of secretion was too scanty to reach the collector. As soon as the material was obtained it was sent to the laboratory where smears were made immediately, and while still wet were fixed in equal parts of 95 per cent alcohol and ether, and stained by the Papanicolaou technique.

Thin smears are more valuable, for in these all cells can be adequately studied. In preparing the smears, the material was placed in the center of the slide and gently crushed with another slide, care being taken that any granules which may have been present did not escape peripherally. Because of the inequality of the distribution of the cancer cells, an arbitrary figure of 5 smears from each secretion was adopted, and in a few instances as many as 15 smears were prepared.

The secretions were quite characteristic, although not necessarily pathognomonic. The color ranged from gray and watery to somewhat creamy and opaque, but invariably the secretion was either streaked with or diffusely mixed with bright red, pink, or dark brown partially disintegrated blood. It was always tenacious and adhered closely to the side of the collector and glass slide.

One must first become thoroughly familiar with the noncancerous elements in bronchial secretion.

In secretions containing cancer cells, there is a certain appearance which gives one the impression that the preparation should contain cancer cells. The leucocytic elements are in abeyance or entirely absent. The slides appear "cleaner" than do those, for instance, from bronchiectatic cases. Pavement cells are often increased when the tumor is of a squamous cell variety. The erythrocytes are usually fairly abundant.

The following separate groups of cancer cells have been recognized in bronchial secretions:

1. Clusters of cells which are present in squamous cell carcinoma. They are seen as a mass of closely packed, relatively large cells whose cytoplasm stains an orange red and whose nuclei are large and dark blue. Cilia are never present. At the periphery there are usually encountered a few detached single cancer cells. These cells are quite well differentiated and so do not appear as "wild" as do the cells of the more anaplastic tumors.

2. Large irregular single cells found in the more differentiated tumors and in those with adenomatous formation. When the tumor is less well differentiated, in adenomatous formation or a combination of



the two, single cancer cells are found in the secretions. The nuclear-cytoplasmic ratio is increased over normal. The nuclei are single or multiple and usually are extremely bizarre. Nucleoli are not always demonstrable.

3. Smaller more uniform cells present in the so-called oat-cell carcinoma. They are best identified by their size and by the fact that although the cells are similar, there are definite variations in the shape of the nuclei from cell to cell.

A diagnosis of carcinoma can be made on finding a single cancer cell. Usually if there is one cancer cell present there are others also. It can be stated as axiomatic that any cell or group of cells bearing cilia are not cancerous. When bizarre single cells are encountered, there is no question of the process being cancerous.

When one is in doubt as to whether a cell or group of cells are cancerous, the chances are they are innocent. Lymphocytes, basal cells, and macrophages may be confused with cells from an oat-cell type of carcinoma.

In 30 consecutive cases of primary pulmonary carcinoma, cancer cells were demonstrated in 22, or 73 per cent of the cases. In the same series a positive morphological diagnosis, from a study of tissue removed endoscopically, was obtained in 11 cases, or 36 per cent. Cancer cells were present in secretions from 7 cases in which bronchoscopy was negative.

LEE PULLEN, M.D.

Allison, P. R.: Intrapercardial Approach to the Lung Root in the Treatment of Bronchial Carcinoma by Dissection Pneumonecctomy. *J. Thorac. Surg.*, 1946, 15: 99.

A technique of individual ligation of pulmonary vessels after wide opening of the pericardium has been evolved, with the result that those bronchial growths closely set between the hilar structures, those surrounding, or even adherent to, the pulmonary vessels, and those in which the primary growth or secondary glands are adherent to the pericardium, can now be dealt with more radically. When the growth is peripherally placed and the hilar structures are separated by soft glands and areolar tissue, the usual dissection outside the pericardium presents no difficulties. If the vessels are felt stretched over masses of growth, or if neoplastic tissue is felt so near to the pericardium that a good margin of tissue cannot be obtained beyond it, intrapercardial dissection offers a quicker, safer, easier and, at the same time, more radical operation.

The chest is opened by either of the two recognized approaches for lung carcinoma: the anterior incision or the posterolateral incision. The immediate results in surgical removal of the lung for carcinoma depend very much on the spillover of septic secretions into the good lung, and it is therefore of great advantage if the affected bronchus can be occluded either by clamp or strong ligature before much manipulation of the lung takes place. More often this can be done easily by the posterolateral approach.

*Left Side.* The left phrenic nerve is crushed as it crosses the aortic arch. An incision about  $\frac{1}{2}$  inch long is then made in the pericardium immediately in front of, and parallel with, the phrenic nerve. This incision is extended backward over and below the lung root, dividing the phrenic nerve and accompanying vessels which have been understitched and tied. When the outer edge of the pericardium is retracted, the most obvious vessel is the anterior superior pulmonary vein. The reflection between the two veins is easily perforated with curved scissors and the opening enlarged so that the finger can be passed around the vein. The vein should then be hooked forward while the serous reflections are still further divided, both toward and up to the parietal pericardium and inward to the auricle. In this way the length of the vein available for ligature and division inside the pericardium is ample. Number 6 silk ligatures are applied, and then the vein is transfixed between the ligatures, one adjacent to each ligature. The vessel is then divided between the transfixion. The inferior vein is treated in a similar manner.

To isolate the pulmonary artery, the pericardial incision is prolonged upward to the anterior aspect of the artery. The finger can then be passed around the superior and posterior aspects of the vessel to show below, covered by the serous reflection. This reflection is divided and the artery is then free to be treated by double ligature and stitching, as already described for the vein. On the left side the inferior vein may present some difficulty if the anterior approach is used, for it is overlaid by the ventricles, but on the right side it is easily accessible by either approach. The fibrous pericardium over the left main bronchus is then incised. The glands and fibrous tissue from the bifurcation of the trachea, and from within the arch of the aorta, are drawn down. The bronchus is divided and closed by a single terminal continuous stitch. The remaining pericardium behind the lung root is then divided and the lung is removed. This last incision should be well toward the middle line so that the mediastinal tissue between the pericardium and the esophagus can be stripped down in continuity with the glands at the bifurcation of the trachea.

In cases in which a growth occurs in the left upper lobe, and especially when the posterolateral approach is used, it may be easy first to cut the lateral pulmonary ligament and then to divide the posterior inferior vein outside the pericardium. If malignant tissue involves the superior vein, it may be necessary to dissect the vein and upper border of the auricle to dissect the main pulmonary artery and to make the section through the auricle itself rather than divide the veins separately. In this event it is useful to tie a ligature of stout colostomy silk around the isolated part of the auricle. Three traction sutures of fine silk are then inserted in the auricular wall, distal to the ligature. Clamps are applied still more distally and the auricle is divided between the clamps and the traction sutures and finally stitched up with

continuous fine silk. The traction sutures may then be lightly tied or removed.

**Right Side.** The incision of the pericardium in front of the lung root passes backward above, dividing the phrenic nerve and vessels and reaching the angle between the superior vena cava and the right pulmonary artery. Here the serous coat is reflected on the under surface of the artery, leaving a fornix in front and behind. The fibrous pericardium, as it plays out in the angle between the two vessels, is divided, and the serous reflection of the anterior fornix is cut. The finger can then be passed through the posterior fornix into the postcaval recess, and a long length of pulmonary artery exposed. It is doubly ligatured, stitched, and divided. The pulmonary veins on the right side sometimes join so soon after entering the pericardium that they are more easily treated as a single vessel. The vessel is really a part of the left antrum and has a fairly thick muscular wall. Below the inferior pulmonary vein the double layer passing on to the inferior vena cava is divided. Access to the posterior surface of the antrum is then possible, and after the serous reflections above the superior vein have been divided, it can be treated in the manner described for the left side. It may be necessary, in order to leave enough room for division, to omit the distal ligature and apply a clamp. In such circumstances it has usually been considered wise to tie off the pulmonary artery before dividing the veins, so that if the clamp slips, the loss of blood is only that which would be removed with the lung.

On either side no attempt is made to close the pericardial sac. It is considered an essential part of the operation that the pericardial sac be left in wide communication with the pleural space, into which it drains freely. This applies whether or not contamination of the pleura is thought to have occurred. It may be found necessary to insert one or two sutures to prevent prolapse of the heart or part of the heart into the pleura, otherwise impairment of cardiac function might occur from the strangulating action of the cut edge of the pericardium.

The most important points in bronchial closure are section of the bronchus as close as possible to the trachea, simple terminal suture, and a good cover of pleural membrane with mediastinal tissue which must be stitched to the stump well above the line of bronchial suture.

The above technique was used in 10 patients who were otherwise considered to be inoperable. Five of these cases came to autopsy. The remaining 5 patients are still alive.

The author states that no conclusion can be drawn about the relative merits of extrapericardial and intrapericardial dissection in respect to the end results. Sepsis seems to be no contraindication to opening the pericardium as long as it is left in free communication with the pleural space afterward. The pericardial sac appears to drain into the pleura and become sealed off in from 2 to 3 days.

LEE PULLEN, M.D.

Mandeville, F. B.: Roentgen and Clinical Problems in So-called Solitary Metastatic Tumors in the Chest. *Am. J. Surg.*, 1946, 71: 669.

Because the tremendous acquisition of skill and experience by thoracic surgeons has increased the responsibilities of the radiologist in the examination and diagnosis of chest tumors, the author's object is to consider the management of solitary metastatic tumors of the chest without drawing any rigid or final irrevocable conclusions.

Five cases seen during his x-ray experience were subsequently operated upon and illustrated that thoracic surgery has reached a state of perfection in which survival after operative removal of metastatic chest tumors is obtainable. In 1 instance a primary hypernephroma was missed until the pathologist had studied the sections of an excised chest tumor assumed to be primary. Subsequent intravenous pyelography showed an enormous left kidney tumor with poor function and very poorly outlined and deformed pelvis and calyces. Within 6 months the lungs showed multiple oval metastatic nodules and death soon followed. Error in this case was disastrous and shows how the responsibilities of the radiologist have increased.

Personal communications of many thoracic surgeons over a period of years emphasize that in certain cases in which the primary tumor has been removed and an apparently single late metastatic lesion appears, operative intervention is being considered as a chance possibility of completely eradicating the disease. Relief of pain, alleviation of respiratory distress, and removal of a focus which might give rise to tertiary metastases have been other arguments in favor of surgery.

Eight reports of surgical removal of apparently solitary metastatic chest tumors have been abstracted from the medical literature.

A most discouraging argument has been the lack of enthusiasm shown by pathologists as a group for these procedures, since proved solitary metastatic tumors in the chest appear to be rare at autopsy and unlikely in the light of Batson's contribution on the vertebral veins as a channel for spread.

In considering exploratory thoracotomy it is difficult to differentiate benign from malignant tumors of the chest by roentgen means alone, and it is also difficult to differentiate many primary from solitary metastatic tumors with x-rays.

We lack knowledge of the natural history of primary tumors and their metastases which makes prognosis difficult when they are treated surgically or when they are not treated. Metastases sometimes manifest themselves from 5 to 15 years after proof of existence of the primary cancer.

Other means than surgical, such as radiation therapy, are inadequate in dealing with primary or metastatic tumors of the lung.

The many problems of solitary metastatic tumors of the chest remain unsolved, but the author calls attention to treatment which is as yet of a highly experimental nature.

LYNN JOHNSON, M.D.

Santas, A. A.: The Technique of Lobectomy, with Especial Reference to the Individual Ligation of the Parts of the Pedicle (*Técnica de la lobectomía, con especial referencia al procedimiento de la ligadura individual de los elementos del pedículo*). *Bolet. Inst. clin. quir.*, B. Aires, 1945, 21: 421.

Santas considers that the evident progress during the last few years in the field of thoracic surgery has been due to several factors such as the proper anesthesia, the better systematization of patients, the positive pressure and tracheal intubation, and the preventive treatment of shock. He describes the anatomy of the bronchi and the arteries of the lungs.

According to his experience he has found the individual bronchovascular ligature to be the elective procedure in the lobectomy operation. In doing the individual ligations of both the bronchi and vessels he found that the lobectomy was more complete and that the chances of cicatrization without infection were greater. The pleuralization of the stump and the proper drainage during at least from 48 to 72 hours are measures of importance for the success of the operation. The operating technique of lobectomies in general as well as of lobectomies concerning each particular lobule are described. The indications in general are discussed.

The anesthesia most commonly used is cyclopropane-ether given by tracheal intubation. The transitory phrenic inhibition is made by novocain injection in the neck or, if paralysis of the diaphragm is not essential, the opening of the thorax is made by an intercostal incision or by resection of one or more ribs.

Once the thoracic cavity is opened, gauze wet with saline solution is placed in the borders of the wound. The dissection of the incisura of the lung should be complete. Before dissection of the hilum the vascular elements should be recognized to avoid hemorrhage. Before the bronchi are approached the pleural cavity should be isolated to avoid its contamination. The bronchi are ligated with a U ligature and section of the bronchi is done with an X ligature. Unnecessary trauma of the pleura should be avoided. It is considered good practice to add sulfonamide powder to the pleura before the wound is closed. Proper drainage during the first 48 to 72 hours is indicated.

After the pleuralization is done expansion of the lung is initiated. The suture of the different layers of tissues of the operative wound is done methodically, and an attempt is made to close the pleural cavity entirely. WILLIAM E. RICKETTS, M.D.

#### ESOPHAGUS AND MEDIASTINUM

Leegaard, T.: Corrosive Injuries of the Esophagus; with Particular Reference to the Treatment of Acute Corrosive Esophagitis. *J. Lar. Otol.*, Lond., 1945, 60: 389.

In the Ear, Nose, and Throat Department of the Rikshospital, Oslo, 29 patients in all, with recent corrosive injuries and strictures of the esophagus,

were admitted during the 10 year period from 1933 to 1942. Of these 12 were children between 1 and 3 years of age, and 10 were children between 4 and 10 years of age.

Since May 1, 1943, a total of 52 such patients have been treated. Thirty-four of these 52 had fairly recent injuries, and 30 were children under the age of 3.

The increase in the cases is apparently due to the increased use of chemical washing materials during war conditions. Perhaps the children's unsatisfied craving for sweets also plays a role.

Corrosive injuries of the esophagus may be seen in patients of all ages. In adults, accidents, carelessness, and, perhaps most often, attempted suicide are responsible. In children they are due almost constantly to negligence on the part of the relatives.

Corrosive injuries may arise from swallowing acids and alkalis, but in the majority of cases they are due to the careless use of chemical washing materials, solutions of lye, and, more rarely, caustic soda in substance or washing powders. In some cases the author has seen severe corrosive injuries in children who have drunk essence of vinegar, i.e., concentrated acetic acid.

The symptoms depend on the concentration of the corrosive substance and on the amount swallowed. A single gulp, especially in children, can produce very severe injuries.

The patients have burning, smarting pains in the mouth and throat. Edema and injection of the mucosa appears, and eventually white corrosion marks are found on the lips, tongue, palate, and in the throat. Edema in the laryngeal aperture may cause respiratory obstruction. Difficulty in swallowing appears with marked salivation and vomiting, which may be blood stained.

Somewhat later, pains in the chest, radiating to the back, occur and indicate rather a deep lesion of the esophageal wall. In such cases fever is also observed and it may be quite high. Other toxic symptoms, with a state of severe generalized exhaustion, may be present and lead to death in the course of a day or two. In some cases acute corrosive esophagitis may lead to serious developments even after the immediate danger is over.

In deep corrosion of the esophageal wall, periesophageal changes, perforation of the wall, purulent esophagitis, and mediastinitis appear and may become circumscribed, but sometimes they break through to the pleura and pericardium, and produce purulent pleurisy and pericarditis. Rupture into the trachea or bronchi is also seen.

If the patient does not die as the immediate result of the accident, the acute symptoms subsequently recede in most cases, the patient is again able to begin swallowing, first fluids, then soft food, and often any kind of food. After 3 or 4 weeks the difficulty in swallowing recurs, and the increasing after-effects of corrosion produce a more or less severe constriction of the gullet. In a great many cases the patients, in spite of treatment, suffer trouble for the rest of their lives. Food must always be chewed

finely, since even small pieces may stick, particularly pieces of apple, and potato. The state of nutrition may suffer because of this, and the resistance to disease may be lowered. Moreover, there is the continuous danger of fatal complications produced by lesions resulting from the passage of bougies and attempts to remove foreign bodies.

Diagnosis is usually easy. It may, however, be difficult to determine the localization of the corrosion and its depth.

The localization of the stricture due to corrosion in 30 patients, whose case histories contain sufficient relative data, was as follows:

Esophageal mouth	2
Between the mouth of the esophagus and bifurcation	9
Bifurcation	7
Between the bifurcation and the hiatal region	7
Hiatal region	3
Whole esophagus	2

From this, it appears that the lower half of the esophagus is more frequently attacked than the upper. No special attraction for the physiologically narrow places appears to be indicated in this series.

The prognosis is not particularly good. However, the mortality figures vary considerably among the different writers. Von Hacker gives the mortality as between 40 and 50 per cent, Billroth 38 per cent, Belinoff 27 per cent, and Erdelvi between 20 and 23 per cent.

In cases of severe corrosion most deaths occur during the acute stage, and the patients who are "cured" with stricture formation are exposed to constant dangers later. In some a poor state of nutrition results in diseases dangerous to life. In all, perforation may follow at any moment as a result of passing bougies. Impacted foreign bodies also bring the danger of complications.

Of the 52 patients treated by the author, 6 died subsequently, 2 of 34 treated in the acute stage, and 4 of 18 treated for stricture.

The prognosis with regard to the functional result is dependent partly on the degree of action of the corrosive, partly on treatment.

Dilatation of esophageal strictures has been carried out for several hundreds of years. The essential point is to begin treatment before the stricture has appeared, before the scar is formed. It is necessary to prevent the stricture, and therefore the scar formation must be controlled. The risk of this early treatment does not appear to be great, judged by the fairly extensive literature which has been written on this subject. However, even if there is, generally speaking, unanimity in regard to the advantage of this early treatment, considerable difference of opinion still reigns as to when it should begin and how it should be carried out.

Treatment in the form of daily passage of soft bougies should begin from 2 to 6 days after the injury. Some workers, however, consider that the beginning of the second week is the most favorable time.

The best treatment of the deeply penetrating necrosis is by means of the use of a retained tube, which is accomplished by the help of an external esophagotomy.

In view of earlier writings and on the basis of the treatment of his own cases, the author recommends that for adults and older children the daily passage of soft bougies should be used in the cases of lesser stricture. In severe cases external esophagotomy is done and a tube is introduced.

A retained catheter introduced through the nose is used for small children in the first year of life for the milder cases, and external esophagotomy with a retained tube is resorted to in severer cases.

This is illustrated with records of the case histories of patients in the different categories.

Subsequently, the treatment of cases in which strictures are already established is briefly discussed. In individual cases dilatation by diathermy of circumscribed scarring can be readily accomplished. This is illustrated by an example.

The author's own material is summarized. It consists of 52 patients, 34 with the diagnosis of acute corrosive esophagitis and 18 with the diagnosis of stricture of the esophagus. External esophagotomy was performed on 15 occasions. In the follow-up of the first group there were 26 cures, 2 cases which were much improved, and 2 deaths. In the follow-up of the second group (strictures) there were 3 apparent cures, 7 cases with great improvement, 1 case without change, the patient dying later, and 3 deaths.

ERNEST E. ARNHEIM, M.D.

#### Johnstone, A. S.: Dysphagia Due to Causes Other Than Malignant Disease. *Edinburgh M. J.*, 1946, 53: 160.

This subject was chosen for the Honeyman Gillespie lecture, which was delivered in the Royal Infirmary on June 7, 1945. All of the causes of difficulty in swallowing other than malignant disease were discussed. The author divided the causes of dysphagia according to the different decades of life. He stressed that difficulties in swallowing may arise from disorders of the complicated physiologic mechanisms involved, from obstructions within the lumen of the esophagus, or from pressure on the outside. He discussed the physiology of swallowing.

In the first decade of life congenital atresia is a rare condition but should be suspected when a newborn infant chokes, coughs, or turns blue on taking its first and subsequent feedings. Eighty per cent of the cases discussed by the author showed a fistula below the lower esophageal segment and the trachea, or a main bronchus. Congenital stricture, web, shortening, and spasm may become manifest during the first few years of life. Boys are more frequently affected than girls.

During the second decade of life a congenital stenosis may become apparent. The roentgenograph will show the esophagus to be dilated above the stenosis. Frequently a foreign body will be present at the point of stenosis and has been the cause of the show-

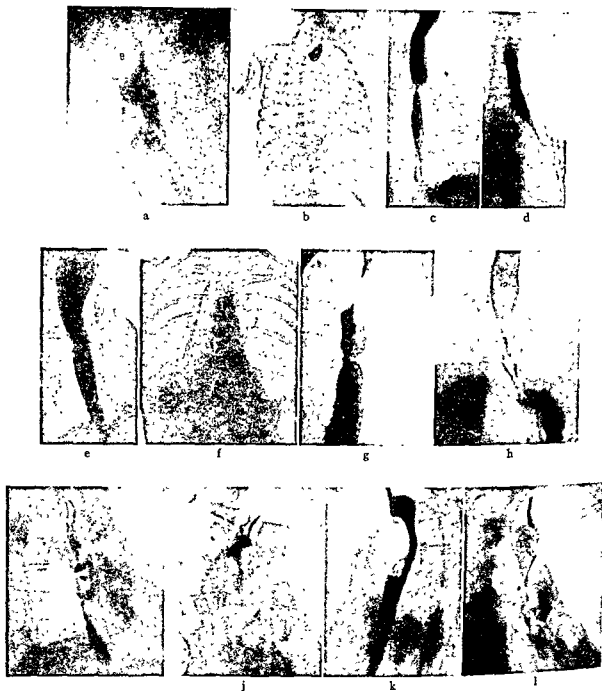


Fig. 1. a, (B) Base of tongue bulging backward and downward as it propels the bolus. (E) Epiglottis turned over. b, Lipiodol filling the esophageal "cul-de-sac." Note air in stomach and bowel denoting tracheoesophageal fistula. c, Typical congenital stenosis in adolescent. Shortening of lower segment. Gastric mucosa seen passing through the esophageal hiatus. d, Early stage of achalasia. Gastric mucosa seen in narrowed segment. e, Early stage in achalasia. Note the serrated outline due to small, irregular contractions; wide dilatation of upper segment; thickening

of the wall. f, Shadow on right of mediastinum caused by dilated esophagus. Bilateral atelectasis of the lower lobes with bronchiectasis. g, Shelflike defect in barium column due to web. h, Peptic ulcer of esophagus. Crater seen due to web. i, Irregular contractions of circular fibers producing "functional diverticula." j and k, Filling defect due to simple tumor. Ring shadow; lobulation; smooth external surface. l, Esophagus displaced anteriorly by rudimentary left aortic arch.

ing up of the stenotic area. Also during this decade the accidental drinking of a corrosive substance seems to occur more frequently, and the degree of dysphagia from acute esophagitis may be very severe.

The most common cause of dysphagia in the third decade is achalasia in its earliest stages. Roentgenology provides evidence in support of the current theory that achalasia is caused by a neuromuscular lesion. One finds a spasm affecting a segment at the lower end of the esophagus from 1 to 2 cm. long. This segment involves the cardia and the cardiac ampulla, or that part of the esophagus lying in and below the diaphragmatic hiatus.

In the fourth and fifth decades we find dysphagia occurring in middle aged women suffering from anemia of the hypochromic, microcytic type. The signs of Patterson-Brown Kelly, and the Plummer-Vinson syndrome, with fissured lips, sore tongue, koilonychia, splenomegaly, and achlorhydria may be present, and any one of these should warn the radiologist to pay special attention to the post-cricoid region. It is interesting to recall that Vinson considered the dysphagia to be hysterical, Brown Kelly believed it was due to spasm, and Patterson suggested that a web might exist as well as spasm.

Careful fluoroscopy may reveal two things—a spasm at the upper end of the esophagus and a web. The first, a narrowing in the post-cricoid region about 1 to 2 cm. long, is seen in the anteroposterior view. It appears to be caused partly by contraction of the lower fibers of cricopharyngeus muscle and partly by the terminal bundles of the muscularis propria of the esophagus. The second is a small projection from the anterior wall which, as it becomes larger, juts out into the column of barium like a thin shelf. The webs may be multiple and are commonly situated in the post-cricoid area but may be found at a lower level.

During the fifth, sixth, and seventh decades the following causes of dysphagia are most common: peptic ulceration of the esophagus and a partial thoracic stomach; pharyngeal diverticulum, tertiary contractions with functional diverticula and benign tumors and nervous lesions; and a group of disorders such as bulbar paralysis, botulism, diphtheria, and myasthenia gravis, which may bring about dysphagia by paralyzing one or more of the muscles of deglutition or by causing loss of sensation. Also extrinsic pressure from cardiovascular causes may result in dysphagia.

PAUL MERRELL, M. D.

Johnstone, A. S., Harper, R. A. K., McLaren, J. W., and Grossmann, M. E.: Symposium; Nonmalignant Conditions of the Esophagus. *Brit. J. Radiol.*, 1946, 19: 101.

The symposium presented is made up of four separate papers by the authors, in the order named. The author of the first paper discusses some of the more unusual causes of dysphagia. The subject is introduced by a rapid but rather detailed description of the esophagus from the standpoint of anatomy, as well as physiology, and some of the newer thoughts

are pointed out. The condition first described is referred to as post-cricoid web. Just how the condition arises is not clear, nor is its relation to associated spasm. Its association with a microcytic hypochromic anemia in middle-aged women, accompanied by other deficiency signs, should forearm the radiologist. Although response to iron is usually notable, further examination to exclude malignant disease is recommended.

Functional diverticula may be produced possibly as a result of abnormal distribution and sequence of esophageal contraction waves. The pathogenesis and the theories advanced to explain these findings are discussed.

Congenital defects of the esophagus are referred to, but the congenital narrowing usually at the level of the bifurcation of the trachea, more common in male children, but occasionally persisting throughout adult life, is developed in some detail.

Peptic ulceration and partial thoracic stomach are discussed. Some points of differentiation between an esophagitis and definite peptic ulceration are presented. The matter of a congenitally short esophagus, epiphrenic pouch, small hiatal hernia, or a definite phrenic ampulla is given considerable attention. Numerous illustrative roentgenograms are appended.

The author of the second paper discusses a large variety of conditions, both congenital and acquired, including those of traumatic, inflammatory, and ulcerative etiology, as well as tumor, anatomical displacements, and such miscellaneous conditions as varices, diverticulum, achalasia, etc. The discussion of each point is rather brief and somewhat in summary, but is supported by good roentgenographic demonstrations.

The third paper refers to a "corkscrew" type of esophagus, as described by Johnstone and Templeton. Some discussion of the etiology is given and good roentgenographic reproductions are appended. Another case is briefly presented of regurgitation into the esophagus in face of a normal emptying time of the stomach in an infant.

The fourth paper concerns 2 cases of achalasia, illustrating the beneficial effects of treatment by octylinitrite with special reference to its action on the cardiac sphincter. The third case reviewed presented a congenital, short esophagus with two diverticula of the lower third of the esophagus, believed to be congenital in nature, and associated with a peptic ulcer of the lower end. A fourth case presented a large chronic duodenal ulcer, also a large chronic ulcer in the lower part of the esophagus, from which a small perforation led into the left auricle. Of course this latter complication was believed to be of short duration.

HIRAM T. LANGSTON, M.D.

Blades, B.: Mediastinal Tumors. *Ann. Surg.*, 1946, 123: 749.

During a period of 3 years 114 patients were operated upon for mediastinal tumors in the Army

Thoracic Surgery Centers in the United States. No neoplasms of lymphoid origin—lymphosarcomas, Hodgkin's disease, or lymphocytoma are included in this series unless the surgical intervention resulted from an erroneous diagnosis. There were 94 benign and 15 malignant tumors. In 5 cases aneurysms were found.

Twenty-three bronchiogenic cysts were removed from the mediastinum. Up to 1945, only 35 cases were reported in the literature. These cysts are located at almost any site along the tracheobronchial tree. Commonly they occupy an anterior or posterior position at the bifurcation of the trachea. Mild substernal pain and cough are the only symptoms; in this series 21 of the cysts were asymptomatic. The rest were detected on x-ray examination. Anteroposterior and lateral films are necessary to differentiate the mass from teratoid or primary nerve tumors. On lateral views, the mass does not occupy the extreme posterior position of primary nerve tumors, and its shadow is less distinct than that of teratoid tumors. The mass usually moves with swallowing as it is attached to the trachea. Bronchograms and esophageal studies often aid in the diagnosis. Grossly, these masses are round or ovoid and are usually attached by a stalk to the carina or bronchus. They may vary from thin walled tumors filled with clear fluid to almost solid neoplasms. It is believed these cysts are developmental abnormalities resulting from a pinching off of a diverticulum of the foregut near the tracheal bud or representing a secondary development of the tracheal bud. Microscopically, one sees any or all tissue normally present in the trachea and bronchomucous glands, cartilage, connective tissue and smooth muscle. Stratified squamous or ciliated pseudostratified epithelium may line the cyst. Surgical removal is the treatment of choice as the preoperative diagnosis is uncertain, the cysts may become infected, increase in size and cause pressure symptoms, or they may potentially become malignant.

Twenty cases of teratoid tumors—dermoids and teratomas—were operated upon, and of these 6 were highly malignant. Teratoid tumors are relatively common, more than 245 being recorded in the literature. They produce sharp and obvious x-ray shadows and are easily detected. Cough and chest pain are the most common symptoms. A case report of a tumor involving the right middle lobe of the lung and causing hemoptysis is given. Teratoid tumors also may cause pressure effects leading to cough, dyspnea, and enlargement of the neck veins. On x-ray examination the characteristic anterior mediastinal position is suggestive, but unless bones or teeth are visible a positive diagnosis is impossible. Only in 3 of the 20 cases was the tumor not in the anterior mediastinum. These tumors may range from thick walled, fluid filled cysts to solid tumors, and vary in size and shape. The tumors frequently contain ectodermal derivatives such as hair, teeth, or skin. It is believed they originate from cell rests. Microscopically, elements of endoderm, ectoderm,

and mesoderm may be found. Often combinations of tissue from the digestive or respiratory tract, thyroid, or thymus are found. Surgical removal is the treatment of choice, since malignant degeneration is not uncommon. X-rays are ineffectual. In the literature 12.9 per cent are reported as showing malignant change. It is emphasized that once malignancy develops, successful treatment is almost impossible.

Twenty-nine benign neurogenic tumors of the mediastinum—neurofibromas, ganglioneuromas, and sympatheticoblastomas—were successfully removed. One case of neurogenic sarcoma was explored and found inoperable. These tumors are more common, 105 being reported by Kent from the literature. Usually these tumors are asymptomatic. If certain nerves are involved pain or a Horner's syndrome may be present. Definite clinical manifestations usually indicate a malignant change. On x-ray examination these tumors are round, spherical, or lobulated, and occupy an extreme posterior position. Careful roentgenograms of the spine for bone erosion may indicate the presence of a dumbbell tumor—a tumor arising in the intervertebral foramen and extending both into the spinal canal and anteriorly into the posterior mediastinum. This spinal canal involvement may be very difficult to detect even at operation. Usually the intercostal and sympathetic nerves are the site of origin. Microscopically, the picture of these tumors varies widely. Often there is a preponderance of fibrous tissue (ganglioneuroma) or of ganglion cells (ganglioneuroma). Lack of differentiation from cellular myxomatous tissue produces a microscopic picture of a myxoid neuroma. Malignant changes are often difficult to determine, and these tumors will recur if incompletely removed. About 37 per cent of primary nerve tumors undergo malignant degeneration, so prompt surgical excision before malignant changes occur is the only hope of cure. X-ray treatment is futile.

Ten pericardial cysts are included in the series; all were asymptomatic. They usually show an anterior position on the roentgenogram. These cysts are anomalies of pericardial development. They are thin walled cysts lined with mesothelial or endothelial cells and lying in contact with the anterior chest wall and the parietal pericardium. Operation is recommended to establish the diagnosis.

Six thymic tumors (4 benign) were studied. One was associated with advanced myasthenia gravis. Four of the patients were asymptomatic, the tumors being discovered on x-ray examination. There are no definite criteria for x-ray diagnosis. In many cases the tumor tends to maintain the shape of the thymus. It is usually seen quite plainly in the anteroposterior projection, but is not so apparent in the lateral view even when it has caused distortion. These tumors lie subinternally in the anterior mediastinum. They are of reddish brown color and have a varied microscopic picture. If benign they look like normal thymic tissue. If malignant they may look like a malignant lymphoma, epidermoid carcinoma,

or a teratoid tumor, or they may be made up of endodermal thymic reticulum cells. If these lesions fail to respond to x-ray therapy, surgical excision is recommended.

Only 4 mediastinal lipomas were removed. They are rare, only 40 being recorded in the literature. They may cause pain, dyspnea, and cough, according to their size and location. On x-ray examination one can sometimes make the diagnosis if the shadow of the mass becomes more opaque toward the periphery. These tumors may be entirely confined within the thoracic cage, may be intrathoracic and extend into the neck, or they may be intrathoracic with an extrathoracic extension. Their microscopic appearance is characteristic. Surgical removal is desirable as these tumors often grow to huge size.

Other mediastinal tumors found were 1 fibroma, 1 thyroid adenoma, 2 tuberculomas, 1 esophageal cyst, and 1 osteochondroma of the mediastinum. Three cases of inflammatory lymph nodes were discovered on exploration, and a Boeck's sarcoid was diagnosed after biopsy.

Fourteen malignant tumors were found—6 malignant teratomas, 2 thymomas, 1 neurosarcoma, 2 lymphoblastomas, and 4 cases of Hodgkin's disease. In only 3 cases was it possible to remove the tumor, and in each case the tumor was a Hodgkin's granuloma. A case is presented in which a posterior mediastinal tumor of unknown origin was removed and proved to be Hodgkin's disease. In the other cases the tumors had hopelessly involved the adjacent structures and biopsy only was carried out.

There is no infallible method of determining the exact nature of a mediastinal mass preoperatively.

Most benign and some malignant tumors of the mediastinum are amenable to surgical removal. Refinement in operative and anesthetic techniques now have made exploration of the chest safe. It is usually possible to make a reasonably accurate diagnosis of mediastinal tumors of lymphatic origin. These are with few exceptions the only mediastinal tumors which will respond to x-ray therapy, so a test dose of x-rays for approximately a month can be tried. If the tumor fails to change in size, surgical exploration to determine its exact nature should be performed. Continued injudicious radiation may be disastrous.

In 114 exploratory thoracotomies there were no deaths attributable to the exploratory operation. Three cases developed suppurative pleuritis which healed promptly with adequate drainage. Therefore operation should not be delayed until signs and symptoms of pain and enlargement of the tumor are present because usually at this time the opportunity for successful removal will be past.

There is no agreement as to the proper surgical approach, the posterolateral, anterior, and lateral being used. If technical difficulties are anticipated the lateral or posterolateral is preferable. Properly administered intratracheal anesthesia has been found to be essential for exploration of the chest and mediastinum.

The author recommends the universal application of routine x-ray examination of the chest in individuals of all ages in order that early diagnosis can be made and adequate surgical treatment of intrathoracic tumors can be instituted.

ROBERT R. BIGELOW, M.D.



# SURGERY OF THE ABDOMEN

## ABDOMINAL WALL AND PERITONEUM

D'Abreu, F., and Humble, J. G.: Mesenteric Venous Thrombosis; Recovery after Resection with Heparin. *Lancet*, Lond., 1946, 1: 534.

A successful case of resection of the small intestine for mesenteric venous thrombosis is described.

A new method of titrating the coagulability of the patient's blood, with heparin solutions of decreasing strength, is preferred to the estimation of the coagulation time.

The use of heparin is urged in cases of thrombophlebitis when dangerous complications are feared.

JOHN J. MALONEY, M.D.

Mattson, H.: Use of the Rectus Sheath and Superior Pubic Ligament in Direct and Recurrent Inguinal Hernia. *Surgery*, 1946, 19: 498.

A method of hernioplasty is described wherein a flap of the anterior rectus and pyramidalis sheath is turned down and sutured to the superior pubic ligament. Such a procedure is believed to be indicated in (1) direct inguinal hernias, (2) indirect inguinal hernias with weak and redundant fascia in Hessel-

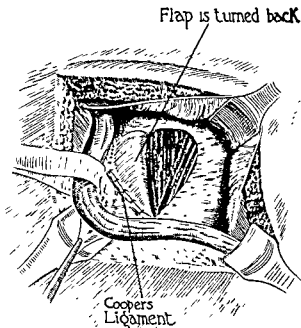


Fig. 1. Illustrating suture of the rectus sheath to the superior pubic ligament.

bach's triangle, (3) recurrent inguinal hernias operated on previously by other methods, and (4) femoral hernias.

SAMUEL KAHN, M.D.

## GASTROINTESTINAL TRACT

Beck, W. C.: Acute Gastroduodenal Obstruction (Dilatation). *Arch. Surg.*, 1946, 52: 538.

It is the author's opinion that the severe symptoms associated with acute gastroduodenal dilatation are almost invariably due to obstruction in the duodenum. The exact site of the obstruction is usually at the point where the superior mesenteric artery crosses the duodenum. Predisposing factors of acute gastroduodenal dilatation include emaciation, ptosis of the viscera, a short mesentery, lordosis of the lumbar portion of the spine, and collapsed intestines, such as are seen in wasting disease. A chronic obstruction of a mechanical type may be transformed into an acute one. The most prominent symptom is vomiting, which is copious in amount and associated with nausea. Vomitus is bile-stained to dark green. The amount of gastric contents aspirated through a stomach tube is usually remarkably large. Pain is not a prominent feature, but when present is situated in the periumbilical area and does not radiate. The abdomen becomes distended in some cases but is flat in others, and abdominal tenderness is either entirely absent, or diffuse and slight. The most striking part of the physical examination is the general appearance of the patient, which is usually one of pronounced loss of weight and emaciation.

The roentgenogram is diagnostic. The scout film reveals pronounced dilatation of the first and second parts of the duodenum. Since the duodenum lies on a different anteroposterior plane than the stomach, the lateral projection is an important one in differentiating dilatation of the two organs. All the roentgenograms must be taken with the patient recumbent, since fluid levels are confusing and contribute nothing to the diagnosis.

Many cases of acute gastroduodenal dilatation are cured by Wangenstein suction, and therefore the differential diagnosis between this syndrome and that of acute intestinal obstruction is not often made. The author's three aims in the treatment are: (1) emptying the stomach and keeping it empty, (2) relieving the obstruction of the duodenum, (3) replenishing the lost electrolytes and maintaining the nutrition or correcting the emaciation. Elevation of the foot of the bed is of value. In milder cases the assumption of the knee-chest position and the use of small, frequent feedings may benefit the patient to such a degree that in a few days he will be able to eat normally. Operative intervention with the performance of a duodenojejunostomy is rarely, if ever, indicated except in cases in which volvulus or congenital bands are present.

A patient who has had an acute arterioesenteric duodenal obstruction should be observed after he has recovered, to determine whether a chronic duodenal ileus is still present.

HAROLD LAUFMAN, M.D.

Mendelsohn, E. A.: Hiatus Hernia of the Stomach as a Source of Gastrointestinal Bleeding. *Radiology*, 1946, 46: 502.

The differential diagnosis of bleeding lesions of the upper gastrointestinal tract must consider hiatus hernia of the stomach which manifests itself in hematemesis, melena, or microcytic anemia.

The hiatus hernia may or may not be combined with a congenitally short esophagus, the presence of which plays an important, but not an exclusive, part in the origin of this condition. Insufficiency of the muscular hiatus and of the surrounding connective tissue, acquired with advancing age, is considered the decisive etiologic factor. The positive pressure within the abdomen gradually forces segments of the stomach through the weakened hiatus into the thorax, where negative pressure exists.

Of the 16 cases of hiatus hernia of the stomach observed in 1,000 consecutive gastrointestinal examinations, the greater number of patients with true hiatus hernia were beyond 50 years of age. There were 8 females and 8 males. In a surprisingly large proportion of the cases (5 out of 16) the diaphragmatic hernia was complicated by other lesions in the gastrointestinal tract. Duodenal ulcers were found in 2 cases, primary adenocarcinoma of the ileum with intestinal obstruction in another, and the 2 remaining patients showed multiple diverticula in the colon. The combination of diaphragmatic hernia with diverticulosis of the colon is well explained by the fact that both conditions are due to senile insufficiency of muscular and connective tissue.

In 3 of the 11 patients in whom no other gastrointestinal lesion was present, the hiatus hernia was practically asymptomatic. In 5, different degrees of epigastric pain and other digestive symptoms were recorded, and sufficiently well explained by the presence of the herniated stomach. A small peptic ulcer was found in only 1 of these patients. There was satisfactory response to medical management in all patients in this group.

The cause of hiatus hernia is considered to be venous congestion in the herniated portion of the stomach, due to muscular compression of the diaphragm. The swollen and congested mucosal layer can easily be traumatized, with the production of superficial bleeding erosions or deeper ulcerations. Accompanying attacks of precordial pain suggesting an acute coronary occlusion, or more chronic anginal seizures, can well be attributed to the constriction of the herniated stomach by the diaphragm, combined with pressure upon the heart itself.

STEPHEN A. ZIEMAN, M.D.

Sandberg, I. R.: On the Treatment of Perforated Gastric and Duodenal Ulcer. *Acta. chir. scand.*, 1946, 93: 467.

The author recommends the following procedure as being the normal method of treatment of perforated gastric and duodenal ulcer: suture alone or, preferably, excision of the ulcer plus suture, covering with an omental flap, mopping of the abdomen, and

gastrostomy. The operation is easy to perform, gives a lower mortality than that occurring with resection, and a good late result may be expected in about 40 per cent of cases. The author believes that with the use of this procedure, a resection can be avoided in many cases. If patients are treated by suture alone, a regular medical-dietetic treatment should follow. However, many patients have symptoms that persist or recur after a period of quiescence, and the control of such symptoms is important, for a secondary resection may later be necessary.

The primary operation may be performed at a small hospital which is equipped for only simple surgical procedures; should resection later become necessary, the patient may be sent to another hospital for operation. The author states that in certain cases a primary resection is to be preferred, but that the indications ought to be clear. A long history of ulcer in which the patient has undergone one or more series of medical-dietetic treatment, a short interval between the occurrence of perforation and the operation, and a but little affected general condition in a rather young or middle-aged patient who does not present signs of some other contraindicating disease, are prerequisite conditions for consideration of a primary resection by an experienced stomach surgeon.

In the case of a duodenal ulcer or a gastric ulcer situated in the pyloric region, a Witzel's fistula, or (better) a duodenal tube should be established. A gastroenterostomy should not be considered because of the risk of development of a peptic ulcer in the jejunum. However, should a primary gastroenterostomy be indicated on account of a marked stenosis, it is believed that a resection ought to be performed, if possible at the same time, in young individuals. In patients over 50 years of age, in whom the risk of peptic jejunal ulcer is not so great, a gastroenterostomy alone is permissible. Local and intravenous administration of sulfathiazole is probably of value. Intravenous drip infusion, and the control of fluid and salt balance are important.

If the diagnosis of perforated ulcer is clinically certain or highly probable, operation should be undertaken immediately without a preceding x-ray examination. However, should x-ray examination be desirable for the purpose of differential diagnosis, and free gas is not visible on the general survey pictures, the examination should be supplemented by having the patient drink a small quantity of opaque medium; thus the diagnosis of perforation or non-perforation is made considerably surer without any risk to the patient.

BENJAMIN GOLDMAN, M.D.

Monti, L.: Perforated Gastric Ulcer in a Patient with Gastric Neurinoma (Ulcer perforata dello stomaco in portatore di neurinoma gastrico). *Arch. ital. chir.*, 1944, 66: 64.

A 50 year old man from the country district was admitted with physical findings of a pleural effusion on the right side. This patient had suffered for a long time from brief respiratory attacks, during one

of which, 3 years ago, he had vomited about a quart of blood. The present attack had begun with fever and general physical decline about a month previous to his hospital entrance. On the day of entry 20 c. c. of clear fluid were withdrawn from the right chest cavity; the condition improved rapidly and a week later no fluid could be demonstrated. About this time, however, the patient lost his appetite and became very weak, the stool became tarry and an extreme anemia was uncovered. Roentgen examination of the gastrointestinal tract failed to disclose anything abnormal, the stomach being covered and obscured by the residual shadow-producing medium in the distended colon. In the succeeding days the anemia improved under transfusions and hypodermic glucose solution; however, 3 weeks after entering the hospital the patient experienced a sudden lacerating pain in the epigastrium, radiating to the entire abdominal region and particularly to the back and right hypochondrium. The abdominal walls became retracted, the face pallid and anxious, and there were signs of physical collapse.

The diagnosis was given as perforated gastric ulcer, and the abdomen was opened under local anesthesia. A perforation was found into the lesser peritoneal cavity, through the posterior wall of the stomach near the lesser curvature. However, near the point of perforation was a nodular tumor the size of an adult fist. Drainage was instituted and the abdomen closed. The patient died that same night.

At autopsy extensive histological examination of a variety of tissues from the principal organs of the abdomen and chest failed to disclose any other changes than those ascribable to a catarrhal condition. The tumor itself exhibited the typical histological picture of a gastric neurinoma, with evidence of healed areas of ulcerative breakdown of the gastric mucosa, and the author believes that the ulceration which produced the perforation, although situated adjacent to the new growth and not involving the tumor mass itself, was nevertheless caused by pressure conditions arising from the rapid growth of the neoplasm. The pleural effusion also might have been due to irritation from the tumor which was adherent to the under surface of the diaphragm. No metastases could be demonstrated.

JOHN W. BRENNAN, M.D.

Illingworth, C. F. W., Scott, L. D. W., and Jamieson, R. A.: Progress after Perforated Peptic Ulcer. *Brit. M. J.*, 1946, 1: 787.

This is a survey of 880 patients treated for acute perforation of peptic ulcer in the Western Infirmary of Glasgow during the years from 1938 to 1943, with 733 (83%) survivals. Of the latter group, 666 could be traced and 596 came in for follow-up examination. Sixty-seven patients were untraced; 10 were traced but living abroad; 17 were traced but all of them refused to co-operate, which makes a total of 94 patients, or 12 per cent of the survivors who were not re-examined.

Ninety-five per cent of the patients were male. The ulcer was situated in the duodenum in 87 per cent of the cases. In all but 10 patients the operation was limited to simple closure of the perforation, and in the remainder a supplemental gastroenterostomy was added. On discharge from the hospital all of the patients were given instructions as to diet and therapy.

At the end of the first year, 60 per cent of the patients remained symptom free, about 20 per cent had had a relapse with mild symptoms, and the remaining 20 per cent had had a severe relapse. With the passage of time the percentage of relapses increased, so that by the end of the fifth year about 30 per cent remained symptom free, 20 per cent had had mild relapses, and 50 per cent had had severe relapses.

In general, the women seemed to fare better than the men, but the number of women was too small to allow any reliable conclusion. Older individuals fared better than younger ones. The influence of the duration of ulceration prior to perforation on subsequent health was interesting. The longer the ulcer had been present before perforation, the poorer the health in the postoperative years. It was surprising to find that there was no difference in the morbidity between the various social grades in this series. This disproves the common belief that the treatment of peptic ulcer has more satisfactory results in private than in hospital practice, and shows that the economic status of the patient does not alter the course.

SAMUEL J. FOGELSON, M.D.

Scott, O. B., and Brunschwig, A.: Submucosal Lipomas of the Stomach: A Review of the Literature and Report of a Case Associated with Carcinoma. *Arch. Surg.*, 1946, 52: 255.

In the last decade there has been an increasing interest in the problems associated with benign tumors of the stomach, which have been considered as relatively rare. Although reports now indicate that they occur with greater frequency than previously supposed, a few of the types of benign tumors may still be considered rare, and, of these, one of the least rare is the submucosal lipoma.

Rumold, in a review of the literature from 1935 to 1940, was able to find 32 cases, to which he added one case of his own, bringing the total to 33. Since then several cases have been reported. The authors review briefly the recent cases and report a case of submucosal lipoma of the pylorus associated with an infiltrative adenocarcinoma.

The cause of the lipomas of the intestinal tract remains unknown. Some authors have suggested the possibility of congenital influences, since a familial pattern was noted by Rumold in his case of submucosal lipoma of the stomach in a patient who had a brother, a sister, and two nephews, all of whom had lipomas of the extremities. The sex incidence is apparently equal.

The lipomas of the stomach may be either subserosal or submucosal, and may be single or multiple. The submucosal types vary from a few millimeters

to several centimeters in diameter and may be sessile or pedunculated. Although their position is variable they often occur in the region of the pylorus and may produce obstructive symptoms. Overlying the tumor the mucosa is usually smooth, but ulceration is not uncommon. Schindler found that a fairly constant feature of submucosal tumors is the stretching of adjacent rugae so that they appear to bridge the space between the top of the tumor and the surrounding mucosa. Grossly and microscopically, these tumors have the characteristics of adipose tissue with some degree of lobulation.

The clinical picture is variable but not unlike that of other benign gastric tumors.

The preoperative diagnosis of benign gastric tumors can often be made by roentgenographic and gastroscopic examinations.

The treatment of submucosal lipomas of the stomach does not differ from that of other benign gastric tumors. Although local excision may suffice, Rumold emphasized that a portion of the involved gastric wall should be excised to avoid the possibility of recurrence.

The occurrence of both carcinoma and lipoma in the stomach, as in this case, is coincidental, as submucosal lipoma is to be regarded neither as a premalignant condition nor as evidence of carcinogenic factors in operation.

HARRY W. FINK, M.D.

Folsie, P. S.: Intestinal Obstruction following Abdominal Battle Wounds. *N. England M. J.*, 1946, 334: 498.

Factors that predispose to the formation of adhesions are multiple bowel perforations and lacerations of the bowel, particularly when these have resulted in considerable peritoneal soiling, hemorrhage, blast, lacerations of the mesentery, delay prior to initial surgery, and infection. Since battle injuries may involve all these factors, it is not surprising that subsequent obstruction often results. The author warns of the constant danger that an enthusiastic surgeon will do too much in cases of this sort. The natural desire to free the bowel completely should be curbed, and attention confined to the few points at which some degree of definite obstruction has occurred.

A totally obstructed patient should be subjected to as little trauma as will accomplish the goal of the operation—namely, re-establishment of the intestinal stream. Once the obstruction has been relieved, functioning bowel, even though densely adherent, should be left alone. It is predicted that many cases of acute intestinal obstruction will be encountered for many years to come in veterans who have suffered abdominal wounds. Five typical cases are presented: one of the cases showed a tangled mass of adhesions involving practically the entire bowel with only the jejunum and the transverse and descending colon free. This case was the only mortality encountered in the series and demonstrated the extreme involvement that may occur.

Early signs and symptoms should receive careful evaluation and close watching. The author suggests

that interval lysis with the installation of amniotic fluid may be advisable when chronic symptoms suggest impending difficulty, but in the present series this form of treatment was not used.

HAROLD LAUFMAN, M.D.

Kautz, F. G., Lisa, J. R., and Kraft, E.: Congenital Duodenal Obstruction. Report of Cases and Review of the Literature. *Radiology*, 1946, 46: 334.

Congenital obstruction of the duodenum, first described by Calder in 1733, was long considered a fatal malformation of the newborn and a subject merely of academic interest. In view of the rapid downhill course within a week or two after birth, the diagnosis was formerly made by the pathologist at the autopsy table. More recently, however, the condition has been recognized clinically and roentgenologically, and during the past decade surgical procedures have been carried out successfully.

So far about 300 cases have been recorded in the literature. Approximately 50 patients have been operated upon, one-half of whom survived. Improved methods, introduced by Ladd, Donovan, and their coworkers, have reduced the mortality rate still further. In spite of these advances, however, the disorder has received but little attention in the roentgen literature.

Congenital obstruction of the duodenum in its complete form is incompatible with life. Since the

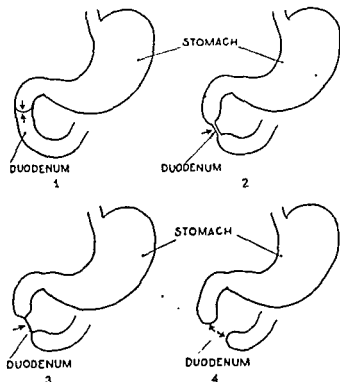


Fig. 1. Four types of congenital duodenal obstruction: 1. Diaphragm (arrows) with or without perforation, most frequent type. 2. Filiform lumen (arrow). 3. Blind ends connected by fibrous cord (arrow). 4. Blind ends without connection (arrows) (aplasia).

downhill course is rapid, survival depends on a correct roentgen diagnosis and an emergency operation within the first week of life. When the surgeon succeeds in establishing continuity of the intestine and in excluding coexistent malformations elsewhere, the prognosis is favorable.

The characteristic roentgen findings of atresia and subtotal stenosis are dilatation of the stomach and gross distention of the duodenum, sometimes with an hourglass appearance, complete 6-hour residue, and lack of intestinal pattern.

Four cases of atresia and 2 cases of subtotal stenosis are reported. The essential clinical and pathological features are discussed. The literature is reviewed.

JOHN E. KIRKPATRICK, M.D.

Hicken, N. F., Snow, S., Coray, O. B., and Jackson, E. G.: Complete Duodenal Obstruction In the Newborn. *Am. J. Surg.*, 1946, 71: 461.

Five cases of acute obstruction of the duodenum occurring in the newborn are presented. The factors causing complete duodenal obstruction in the newborn may be classified as those producing intrinsic occlusion and those producing extrinsic compression of the bowel lumen. The intrinsic occlusions represent a failure of the duodenum to form a patulous lumen. If the entire duodenum remains as a solid cord, the condition is complete congenital atresia. Occasionally a partial or segmental vacuolation occurs which causes a portion of the duodenum to be normal while other segments have no lumen. In rare instances the entire duodenum may be patulous except for a small transverse diaphragm which prevents the flow of duodenal fluids into the jejunum. The extrinsic obstructions are caused by external compression of a normally developed duodenum.

The cardinal symptom is vomiting, which begins shortly after the first feeding and becomes progressively worse until it assumes a pernicious nature. Because the occlusions generally lie below the ampulla of Vater, the vomitus is stained with bile, but the meconium is acholic. Should there be a complete atresia of the duodenum, or if the obstruction is situated at the level of the ampulla of Vater, neither the regurgitated food nor the stools contain biliary pigments. In suprapapillary obstructions the vomitus is acholic while the meconium is stained with bile. Whenever the obstructive agent interferes with the flow of bile into the duodenum, the infant becomes jaundiced. Distention is invariably present and is always limited to the epigastric area, while the lower abdomen remains flat, because the ingested air and gas do not pass into the small intestines and colon below the level of obstruction. Dehydration, electrolyte imbalance, inanition, and mild hyperthermic reactions develop rapidly.

Although clinical observations may suggest the diagnosis of acute intestinal obstruction, roentgenographic studies are necessary for accurate localization of the lesion. Simple films of the abdomen may demonstrate gaseous distention of the stomach and duodenum but fail to outline gas bubbles in the

lower intestines. If an enema has been given prior to x-ray examination, the accidental introduction of air into the colon may lead to an erroneous conclusion of a patent intestinal tract. If the gas bubbles do not change their position on changing the position of the patient, a fixed congenital deformity can be assumed. When contrast media are used for x-ray studies care must be exercised to prevent the aspiration of this material. The hazard can be minimized by injecting the barium mixtures through a small Levine tube and aspirating the mixture by gently lavaging the stomach at the conclusion of the study. Detection of a faulty rotation of the midgut can be made by employing a barium enema.

Thorough preoperative preparation with fluids, transfusions, vitamin administration, and constant decompression of the dilated stomach are essential. The primary objective of every operation is to relieve the obstruction in the quickest and safest manner possible. Many of the procedures which are applicable to adults cannot be used in infants because of the profound physiological disturbances which they produce. Reconstructive measures should aim to divert the essential digestive juices into those segments of the intestinal tract where they normally function. When confronted with complete atresia of the duodenum one must relieve the gastric obstruction and decompress the obstructed extrahepatic biliary radicals. This requires two separate procedures. The authors have employed both antecolic and posterior gastroenterostomies to relieve the duodenal stasis but advise the antecolic anastomosis if the infant is in a precarious state. The biliary stasis can best be corrected by performing a cholecystogastrostomy. The tip of the indwelling Levine tube is pulled through the newly formed stoma so that it lies within the lumen of the gall bladder and provides for biliary decompression. Nonrotation or incomplete rotation of the midgut may produce so much tension on the short superior mesenteric vessels that an acute obstructive angulation of the duodenum may be produced at its junction with the jejunum. In some instances, release of the adhesions may correct the kinking, but as a rule the vascular pedicle is so short that duodenojejunosomy is necessary.

In this series of 5 cases there was an overall mortality of 80 per cent. In retrospect, the authors believe that an early diagnosis combined with corrective surgery might have saved 4 of the 5 patients. They emphasize the fact that the cicatricial bands which are compressing the duodenum may not be solely responsible for the obstruction. In 2 of their patients there was an associated segmental atresia of the duodenal lumen.

JOHN L. LINDQUIST, M.D.

Mehn, W. H., and Morrow, W. J.: Enterogenous Cyst of the Ileocecal Region. *J. Pediat.*, S. Louis, 1946, 28: 605.

Enterogenous developmental cysts of the ileocecal region are infrequent. They may occur anywhere

from the base of the tongue to the rectum, but they are most commonly found in the region of the ileocecal valve.

Enteric cysts arise from and reproduce the structure of the normal intestinal wall. They are lined by intestinal mucosa and their walls contain varying amounts of fibrous tissue and smooth muscle. They may protrude into the bowel lumen or extend outside of the wall according to whether they grow submucosally or subserosally. Attachment to the mesenteric border is common. The cavities of the cyst are unconnected with the lumen of the bowel and contain mucus.

The authors report 1 case, that of a 14 day old male infant in whom the findings, although not entirely typical, warranted a preoperative diagnosis of acute intussusception. At operation an obstructing cyst was found in the lumen of the terminal ileum. This was resected with the adjacent bowel, and a primary anastomosis was made between the ileum and the ascending colon. Examination of the surgical specimen showed no communication between the mucus-filled cyst and the intestinal lumen. Microscopically, the cyst wall contained layers resembling those of the terminal ileum. The clinical, surgical, and pathological findings in this case are comparable to those described by previous authors.

JOSEPH GASTER, M.D.

De Pablo, J. S., and Trallero, S.: A Probable Case of Traumatic Appendicitis (Un probable caso de apendicitis traumática). *Actas Soc. ciruj.*, Madrid, 1945, 5: 33.

This article discusses the probability of traumatic appendicitis and reviews the medicolegal aspects of this condition. A case report in which every evidence pointed to trauma as the cause of the appendicitis is presented.

A 14 year old boy was struck in the abdomen while playing ball. The pain was so intense that it impeded his play. After a few minutes of respite, however, he continued the game. The pain recurred and he was in distress that night and the next day. A little later it became localized and intense in the lower right quadrant of his abdomen and was associated with nausea and vomiting.

His leucocyte count was 21,000 with 70 per cent segmental cells. At operation a retrocecal appendix was found, greatly swollen and edematous in its distal portion. Dense fibrous exudate was present. The appendix was removed and the postoperative course was uneventful. Gross examination of the appendix showed a gangrenous appearing organ with mucosa of a bluish color. There were no visible perforations and the mucosa and serosa were edematous and densely infiltrated. At the base was an olive pit.

The authors review the literature on the pathogenesis of traumatic appendicitis and query whether one traumatic stroke in the abdomen is capable of producing appendicitis, or whether a lesion is formed which permits the entrance of bacteria and infection.

The frequency and prognosis of such lesions are discussed.

STEPHEN A. ZIEMAN, M.D.

Keyes, E. L., and Cook, M. M.: The Diagnosis of Acute Appendicitis in the Presence of Diarrhea. *Arch. Surg.*, 1946, 52: 429.

The authors point out that the diagnosis of early appendicitis is difficult, especially in the presence of diarrhea, in which the picture might resemble that of acute enteritis. They stress the importance of a carefully taken history and point out several features which should help to differentiate the two diseases.

Table 1, below, summarizes the findings in the cases reported by the authors.

The authors call the phenomena listed in this table under points 1 to 4 "gas stoppage sensation" ("a patient is apt to feel that if he 'could pass gas' he might obtain relief from the 'continual gripe' or the 'tight feeling' . . .") and consider it as very characteristic for early acute appendicitis. One may expect positive answers to questions asked in reference to these points in 60 to 80 per cent of all patients with acute appendicitis. The gas stoppage sensation is absent in every patient with perforated peptic ulcer, renal disease, and gallstone colic. In acute cholecystitis it was always absent except in 1 patient; it was absent in acute salpingitis, except in 2 cases and in ruptured ectopic gestation, except in 2 cases; and it was absent in 150 cases of acute enteritis. It occurs constantly at the onset of acute small bowel obstruction, although in such cases vomiting rapidly comes to exceed the downward urge.

As to the time element, the authors show that pain in enteritis is intermittent, in spells lasting for minutes and disappearing for minutes, while pain in

TABLE 1.—DIFFERENTIAL DIAGNOSIS OF EARLY ACUTE APPENDICITIS AND ENTERITIS

Point	History	Acute appendicitis early stage	Enteritis
1	Pain	Persistent in midline despite defecation	Varying situation; intermittent; relieved by defecation completely, if temporarily
2	Bowel urge	Associated with pain; persists despite defecation	Associated with pain; relieved by defecation completely, if temporarily
3	Diarrhea	Uncommon; subordinate to bowel urge	May dominate clinical picture
4	Nausea	Subordinate to bowel urge; occurs subsequent to pain	May exceed bowel urge; may precede pain
5	Vomiting	Present in less than half the cases	Present in over half the cases
6	Tenderness	Physical Findings None in some cases; epigastric, periumbilical or rectal in others	None in some cases, variable in others; bowel sounds may be hyperactive
7	Fever	None or slight	Same
8	White blood cell count	Laboratory Findings Usually over 10,000	Lower average

appendicitis lasts for hours or days, and in recurrent appendicitis pain is continuous, occurring in distinct prolonged attacks.

When the process localizes in appendicitis the following table is applicable:

Point	History	Acute appendicitis, late stage	Enteritis
1	Pain	Shifts to right lower quadrant; may shift elsewhere; may fail to localize	Rarely shifts
2	Bowel urge	Usually disappears	Usually persists intermittently
3	Tenderness	Physical Findings In right lower quadrant, increasing toward McBurney's point, may be atypically situated, occasionally absent; rectal tenderness common	Usually less pronounced and more variable in situation; bowel sounds may be hyperactive
4	Spasm and rebound	Common; cough and rebound tenderness common	Rare
5	Fever	Normal to 102, occasionally higher	Lower or higher
6	White blood cell count	Laboratory Findings Average—15,100 to 15,900	Average 12,400

As to vomiting, the authors stress that it occurs less often in early acute appendicitis than is supposed by some authors, while it is quite frequent in acute enteritis.

This is a careful clinical study which might well be read in the original. **HEINRICH LAMM, M.D.**

**Berk, J. E.: Carcinoma of the Colon and Rectum.**  
*Med. Clin. N. America*, 1946, 30: 307.

Benign colonic neoplasms, such as adenomatous polyps, may undergo malignant transformation. The possibility of a potentially malignant state in the colon acting as a precursor to the development of carcinoma is an attractive hypothesis, but it remains to be proved that the changes noted are precursors and not effects of the cancer. Inflammatory lesions of the colon may predispose to the development of malignancy. The consensus is that the polypoid lesions of ulcerative colitis may become malignant, but probably do so rarely. Diverticulitis has long been thought to predispose to cancer. The important thing to bear in mind is that an individual with diverticulitis may also have a carcinoma.

Anal cancer may take origin in fistulas, inflamed fissures and anal tags, and other inflammatory lesions of the anus but this is an exceedingly rare occurrence. Chronic irritation of the colon, as from constipation and parasitic infestations, appears to play little or no rôle in the production of cancer. A predisposition toward colonic cancer may be an inherited susceptibility for the actual development of carcinoma.

About two-thirds of the malignant tumors of the large bowel involve the left colon and about one-

third, the right colon. The rectum, sigmoid flexure, cecum and ascending colon, transverse colon, descending colon, hepatic flexure, and splenic flexure tend to be involved in the given order with regard to frequency.

Adenocarcinomas of the large intestine may be divided into four main types:

1. Nodular. This type projects into the lumen as a globular sort of mass which frequently ulcerates

2. Scirrhus. Intestinal obstruction is frequent in this type. It is rare in the rectum and is found more often in the left than in the right side of the colon.

3. Colloid. This type is found most commonly in the rectum and rectosigmoid and in the cecum and ascending colon.

4. Papillary. These tumors are not very common and tend to occur most often in the left colon.

Numerous schemes have been advanced to classify carcinomas of the large intestine as to their grade of malignancy. The various criteria used include: (1) the boundaries reached (Dukes); (2) the pace of growth determined by the percentage content of differentiated as compared with undifferentiated cells observed microscopically (Broders); (3) the degree of histological differentiation; and (4) the amount of mucin demonstrable in the cancer cell, on the presumption that the mucus formation is an expression of cell function.

The tendency to metastasize is generally greatest in the rectum and sigmoid and least in the cecum. Investigators have shown (1) that age apparently exerts no important influence; (2) that there is no correlation between the size of the lesion and the presence of metastasis, the incidence of metastasis being even higher in persons with smaller lesions than in those with larger ones; (3) that the higher the grade of malignancy the more likely the presence of nodule metastasis; and (4) that retrograde spread and interrupted spread may occur with normal nodes intervening between the primary site and the next nearest involved node.

The average age of patients with cancer of the colon or rectum is 55 years with 85 to 90 per cent of the cases occurring in persons older than 40 years.

The duration of symptoms before diagnosis is longer on the right side of the colon than on the left side of the colon. In the early stage any symptom sufficient to attract attention to the bowel may be a symptom of cancer. In patients with carcinoma of the right colon, constitutional symptoms are prominent and a tumor mass is often palpable while obstruction is not very common. Characteristically, no blood is grossly discernible in the stools. The symptoms that characterize carcinoma of the left colon are predominantly those of intestinal obstruction. The progressive character of the constipation is of the greatest importance. Visible blood loosely attached to the outside of the stool is observed by approximately one-fourth of the patients.

Carcinoma of the rectum is characterized in the main by a change in the character of the stool, alter-





terminal bowel as low as possible and yield more accurate information with regard to the position of the terminal bowel in cases of imperforate anus.

The cardinal points in the treatment of imperforate anus are: (1) there is no need to hurry, and patients need not be rushed into the operating room improperly prepared, simply because of evidences of distention; (2) finger pressure in the perineum toward the terminal bowel will reveal the distance to be covered; (3) a small incision should be made to permit the finger to bore its way to the bowel instead of laying the perineum wide open, thus opening a large raw area for secondary infection as well as destruction of the sphincter; (4) when the bowel is reached, sweep the finger around it to free it, grasp the lowest point with a clamp, and with gentle traction on this, gradually free it all around until it can be brought down as far as possible; (5) if the entire bowel can be brought to the skin surface, open it and suture it to the surrounding skin; if only part way, anchor it on the four quadrants to the surrounding muscles, open the end, free and bring the mucosa down and suture it to the skin; (6) because of the danger of skin contraction, these cases must be dilated weekly at least, until they are about 1 year old; (7) no anesthesia is required when operating through the perineum during the first week of life.

In some cases complete descent of the bowel will not occur until some 48 hours after birth, while in others it will not take place until the patients are four or five days old. Thus a waiting policy up to a certain limit is desirable. Even the appearance of meconium in the urine, indicative of fistula into the urinary tract, is not an indication for hasty action. The lack of intestinal flora at this age and the feeding of sterilized foods and liquids will delay the danger of ascending urinary infection.

The author stresses his belief that the great majority of these cases can be reached through the perineum without colostomy if they are permitted sufficient time to develop or distend their terminal bowel. However, one case is reported in which there was no rectum or anal canal in connection with the maldevelopment of the sacral bones and coccyx. The terminal end of the bowel was in the sigmoid region. Because this baby passed meconium in his urine, the author established a colostomy under local anesthesia. Another case was that of a 4-month old child who had never had a normal movement of solid or semisolid material. He was born with an imperforate anus, but when 3 days old, a small fistula developed near the base of the scrotum, through which liquid and gas were evacuated daily. Despite this defect, the child appeared well nourished. In another baby with an imperforate anus, a fistulous opening developed (after 48 hours of life) in the middle of the posterior surface of the scrotum, through which a small amount of meconium escaped. By the end of that day, the entire rectal ampulla was distended. By the following day a stricture in the sigmoid had dilated spontaneously and the rectum was well distended down almost to the perineum.

Operation was performed at 80 hours of age with an uneventful convalescence.

Daily dilatations are required in most cases because of the tendency for the skin about the operative opening to contract. If distention reaches the frightening stage, the danger is in aspiration suffocation, and not in toxicity. This danger can be markedly avoided by keeping the baby on its ventral surface entirely.

HAROLD LAUFMAN, M.D.

Folsie, P. S.: Closure of Colostomies. *N. England J. M.*, 1946, 234: 464.

The closure of colostomies in 26 cases following battle injuries is reviewed. In most cases of injury to the large bowel, the injured site had been exteriorized, and most of the cases that presented any great amount of bowel damage had been subjected to a colostomy. Only in occasional cases did the record state that the limbs of the bowel had been sutured together to form a well defined spur. By digital examination, however, it was possible to decide which cases were suitable for crushing, and most of the cases were prepared for closure in this manner.

In 26 cases the colostomies were closed by applying clamps to reduce the septum between the bowel loops, and this was followed by simple transverse suture of the stoma, after the bowel had been freed to below the peritoneum, and the adjacent rim of skin with any protruding and edematous portion of the bowel had been resected. It was usually found that this section of the bowel was fairly well walled off from the general peritoneal cavity by intraperitoneal adhesions, and no attempt was made to free them. After closure the bowel was dropped into the abdominal cavity and the peritoneum was closed over it, but the adhesions were not completely freed in the general peritoneal cavity. The patients had extremely little postoperative reaction or distention. Such a procedure can be carried out through a small elliptical incision, a small margin of skin around the stoma being excised, even when it is situated well in the flank or close to the inguinal region. In only 2 cases were the loops resected and the free ends anastomosed.

A practical criterion as to the adequacy of the preparation is the patient's ability to resume normal bowel movements. Patients with evacuations which occurred exclusively through the abdominal stoma began to have normal defecations after some of the opposed bowel wall had been crushed. This function can be tested by plugging the stoma with a vaseline gauze pack and supporting it with a firm pressure dressing.

In some cases there is a question whether sufficient lumen has been left after closure of the bowel. This happens when the opening is particularly large so that its invagination with two layers of sutures may have encroached too much on the amount of lumen present. This is true especially when the absence of a well defined spur has made it advisable to do little or no crushing. In such cases a transverse closure is

Miller, D.: Papilloma of the Gall Bladder. *N. England J. M.*, 1946, 234: 473.

Three cases of papilloma of the gall bladder were observed by the author during the past few months. In each case the preoperative diagnosis was correctly made by roentgen studies of the organ. There appears to be no significant association of papillomas of the gall bladder and carcinoma of this structure. In a study of 1,700 gall bladders, Kirklín reported that 8.5 per cent were found to contain one or more papillomas.

Papillomas appear as projections from the mucous membrane of the gall bladder. The pedicle may be very thin or quite broad. The symptoms which bring the patient under observation are similar to those of chronic cholecystitis. The treatment is cholecystectomy.

The diagnosis can readily be made by roentgen ray examination. The best time for examination is the twentieth hour after ingestion of the dye. Stones usually change their position with succeeding examinations, are often bunched together, and are most frequently found at the fundus. Most papillomas are discrete, do not change position, and are rarely found at the fundus. Adenomas are larger than papillomas, measuring 2 cm. or more in diameter as against 0.5 to 1.0 cm., and are frequently present at the fundus. EARL O. LATIMER, M.D.

Mallet-Guy, P., JeanJean, R., and Feroldi, J.: The Syndrome of the Sphincter of Oddi (La maladie du sphincter d'Oddi). *Lyon chir.*, 1945, 40: 553.

For 20 years there has been periodic reference to the syndrome associated with spasm or stricture of the sphincter of Oddi and a parallel has been drawn between this and the familiar clinical picture of spasm or stricture of the sphincter at the bladder neck.

The contribution made in this article is the manometric study of the bile duct under conditions of sphincter spasm and the visualization of the lesion by means of radiopaque media. These studies were carried out at operation in 35 cases. Hypertonia was reported after cholecystectomy in 4 cases, in connection with a functionless gall bladder in 5 cases, following aseptic cholelithiasis in 3 cases, and in 5 cases of chronic cholecystitis without stones. Seven cases of essential hypertonicity of the sphincter of Oddi are described, 3 cases of generalized hypertonicity of the biliary passages, and 5 cases of hypertonicity of the sphincter with hypotonia of the gall bladder.

As far as the manometric studies were concerned, the following observations were made: the normal pressure in the common bile duct is about 12 cm. of water, but in the pathological cases under discussion the pressure was from 15 to 20 cm. of water in 10 cases, under 12 cm. in 2 cases, and over 20 cm. in 4 cases (25, 28, 30, and 40 cm. respectively). In the gall bladder, the pressure is regarded as normal at 18 cm. of water, or thereabouts, but in this syndrome the pressure was found to be between 20 and 40 in

12 cases, and below 18 (10 to 15) in 4 cases; in 2 cases the pressure was normal. The roentgenographic appearance of stricture is characterized by dilatation of the common duct and a tapering of the radiopaque material as it approaches the sphincter; in the essential hypertonicities the material ends at the sphincter and resembles a finger in a glove.

In 4 cases there was a chronic hypertonicity and sclerosis of the sphincter which was relieved by operation. Histological studies of an excised portion of the sphincter showed smooth muscle hypertrophy and sclerosis. The manometric studies are supported by pressure graphs of the condition found before and after operation and the roentgenographic data are supported by diagrams. There are 4 illustrations of histological studies. Surgically, stricture was relieved by transduodenal section of the circular sphincter without interference with the longitudinal sphincter. Good surgical results are reported.

ADRIEN VER BRUGGEN, M.D.

Mallet-Guy, P., JeanJean, R., and Servetaz, P.: Distant Results in the Treatment of Chronic Pancreatitis by Unilateral Splanchnicotomy (Résultats éloignés de la splanchiectomie unilatérale dans le traitement des pancréatites chroniques). *Lyon chir.*, 1945, 40: 293.

The first observation on the treatment of chronic pancreatitis after the failure of bile drainage, by splanchnicotomy on the left side, was made to the Lyon Surgical Society in November, 1942. This article consists of the report of 9 further cases of a similar kind which responded favorably to the same type of surgical treatment. Detailed case reports are presented, with 2 biopsies of the pancreas and 1 postmortem specimen. In several cases the bile ducts were visualized at operation by roentgen rays after the injection of contrast media. In 9 of the 10 cases the results were excellent from 12 to 35 months after operation. There was 1 death 15 months after operation from pulmonary abscess and it was from this case that the autopsy specimen was obtained.

In all but 1 of the cases other operative procedures on the biliary tracts were first attempted, usually cholecystostomy, although on 3 occasions cholecystogastrostomy was done. In all cases the pancreas was edematous, nodular, hyperemic, and in some there were firm adhesions and fibrosis which would have made pancreatectomy a hazardous procedure. It appears that the body and tail of the pancreas were either more often affected or more affected than the head, with radiation of pain on the left side of the abdomen. In 1 case the head of the pancreas was most conspicuously involved with obstruction of the bile ducts; in this case a cholecystogastrostomy was done with resection of the right major and minor splanchnic nerves. The pain on the left side was relieved by splanchnicotomy on the left side in the other 9 cases.

Biliary hypertonicity is a complication likely to occur because of imbalance in innervation following splanchnicotomy. This may be relieved, after



After laparotomy the fluid film between the liver and the diaphragm is broken, because the pneumoperitoneum is confined to the subphrenic spaces by the adoption of Fowler's position. This has two harmful effects:

1. The weight of the liver is now no longer evenly distributed on the undersurface of the diaphragm but falls on the suspensory ligaments of the liver. That this is a pain-producing event can be confirmed by observing any patient with a recently induced therapeutic pneumoperitoneum who is allowed to sit up, and it is possible that the abnormal stimulus induces a reflex inhibition of respiratory movements (particularly diaphragmatic), and diminution of the vital capacity. It is significant that operative diaphragmatic excursions are found to be slightly greater in extent in recumbency than in the erect position.

2. The abdominal muscles are the normal antagonists of the diaphragm. During expiration their contraction raises the intra-abdominal pressure, and the liver and the diaphragm are pushed, like a piston, into the lower chest. This mechanism is disturbed by the presence of an air-containing space between the diaphragm and the liver. From the purely mechanical point of view, one would expect the post-operative abdominal patient to breathe less efficiently in Fowler's position than lying on his back. In the latter position the air bubble passes anteriorly, and owing to the forward slope of the lumbar spine the

liver falls back into its normal relationship to the diaphragm.

The familiar picture of posterior basal hypostatic pneumonia is likely to become less common if freer movements ensure that all parts of the lungs have their turn to lie uppermost.

Fowler's position, maintained by a pillow behind the knees on which the calves rest, or by the soles of the feet pressing into the mattress, moreover, is particularly likely to induce thrombosis of the vessels in these areas.

The conflicting claims of recumbency and Fowler's position in shocked patients, and in those recovering from anesthesia, sometimes leads to their being propped up while still in a semi-paralytic or shocked condition, and being retained in position by the repeated efforts of the nursing staff and the judicious insertion of pillows at strategic points. This may prove calamitous to an overtaxed vasomotor system or may easily lead to fatal inhalation of secretions from the mouth or of vomit.

No one who has the most superficial acquaintance with nursing will dispute the difficulties entailed to the patient and nurses by the maintenance of Fowler's position, particularly if the patient is very ill. He must make a considerable muscular effort to maintain the position, and if this is not forthcoming he slips down and has to be replaced repeatedly. In either case rest and tranquillity of mind are lost.

STEPHEN A. ZIEMAN, M.D.

biliary manometric studies, by sphincterotomy at the sphincter of Oddi. Mild biliary hypertonia may be relieved by drainage of the duodenum or the use of atropine. The distribution of the 2 splanchnic nerves to the pancreas is not understood, but bilateral splanchnicotomy is not advocated because of possible deleterious effects on the blood pressure. Apparently the splanchnicotomy not only relieves the pain but also the chronic pancreatitis.

ADRIEN VER BRUGGHEM, M.D.

### MISCELLANEOUS

Spalding, J. E.: Fowler's Position. *Lancet*, Lond., 1940, 1: 643.

Spalding believes there is ample evidence to justify the abandonment of Fowler's position. The use of Fowler's position is based on the naive assumption that fluids always flow downhill. Recent criticisms of the position (mostly of an indirect nature) are concerned with its harmful side effects rather than with the central thesis of the prevention of subphrenic abscess.

The right subhepatic (Rutherford Morrison's) space should not be confused with the suprahepatic spaces. The suprahepatic spaces differ from the main peritoneal cavity in respect to the special function of the diaphragmatic lymphatics in the absorption of particulate matter from the peritoneal cavity, and in the pressure changes within the spaces during respiration, whereas the right subhepatic space belongs anatomically and physiologically to the abdominal cavity proper, and its frequent involvement in suppurative is merely the result of its anatomical relationship to the gall bladder, duodenum, and paracolic appendix.

The main route for the removal of particulate matter from the peritoneal cavity is by way of the diaphragmatic peritoneum. There is normally a steady upward flow of intraperitoneal fluid toward and into the subphrenic spaces, where it is absorbed and passes into the diaphragmatic lymphatics.

This upward flow is determined by the differences of pressure between the general peritoneal cavity and the subphrenic spaces. The pressures in the subphrenic spaces vary with the intrapleural pressures and not with the intra-abdominal pressure. Since the intrapleural pressure is negative and the intra-abdominal pressure is above atmospheric, the intraperitoneal fluid is sucked into the subphrenic spaces and is there absorbed by the diaphragmatic lymphatics. This is a *vis a fronte* mechanism applied to the thin film of fluid from the upper end, and the upward movement of such a film obeys the laws of capillary attraction rather than those of gravity. Large effusions will be influenced by gravity to a greater extent, but a proportion of their content is bound to enter the subphrenic spaces, whatever the position of the patient.

This upward flow of intraperitoneal fluid will be arrested if the continuity of the fluid is interrupted. This takes place in pneumoperitoneum if the patient

sits up and the air passes into the subphrenic spaces. Pneumoperitoneum is always present after laparotomy and in perforated ulcer, the two conditions which are responsible for the majority of subphrenic abscesses. Clearly another mechanism is involved.

When a patient with pneumoperitoneum sits up, the air collects in the subphrenic spaces under a pressure which is considerably less than the general intra-abdominal pressure, and undergoes a respiratory fluctuation. If he has at the same time a collection of fluid in the subhepatic region, this will tend to be aspirated past the liver into the subphrenic spaces. It may be objected that if the patient is sitting up there will be no fluid in the subhepatic region, because it will drain into the pelvis. That this is not so can be demonstrated on most patients with perforated duodenal ulcer. On opening the abdomen in such a case, the right subhepatic space is commonly found to be filled with fluid. If the operating table is now tilted into Fowler's position, it will be found that there is little or no leakage of the fluid out of the space. In fact, the right subhepatic space remains closed until the volume of the extravasated fluid exceeds its capacity, and only then does the excess fluid drain away along the paracolic gutter.

This upward movement of intraperitoneal fluid can be demonstrated radiologically in over a quarter of all patients with perforated peptic ulcer, if they are radiographed standing up.

Excluding peptic ulcers, direct infection of the subphrenic spaces from abscesses of the liver or spleen, or descending from the thorax, results from postoperative peritonitis or leaking peptic ulcers. The one factor common in these conditions is the presence of a pneumoperitoneum; and the practice of confining this to the subphrenic spaces by the adoption of Fowler's position facilitates the aspiration of infective fluid from the subhepatic region into the suprahepatic spaces. If the patient lies on his back, the air bubble is situated anteriorly against the abdominal wall, and the liver falls back into its normal relationship to the diaphragm. Even if the bubble is sufficiently large for its upper part to lie anterior to the liver, the subphrenic pneumoperitoneum is now in continuity with the general abdominal pneumoperitoneum across the anterior surface of the liver, and pressure differences caused by the respiratory movements merely cause a shifting of the bubble and not of fluid exudates.

It must be assumed that the normal mechanism has a definite protective value, and that the thin film of fluid enters the spaces at such a rate that the lymphatics are able to cope successfully with it. Moreover, large infected particles such as fecoliths and lumps of infected lymph are probably too large and be propelled upward by the capillary force. On the other hand, the pressure differences occasioned by the pneumoperitoneum probably lead to the aspiration of fluid in bulk, with contained particles of microscopic size, with the result that the local defenses are overwhelmed.

The results in this small number of cases do not permit definitive conclusions, but they suggest that the effects of radium are greater when the circulation to the uterus is increased by a block of the lumbar sympathetic chain. This procedure is also helpful in that the uterine pain is relieved.

HARRY W. FINK, M.D.

#### ADNEXAL AND PERIUTERINE CONDITIONS

Heller, E. L., and Fallin, W.: Ovarian Involvement in Hodgkin's Disease. *Arch. Path.*, Chic., 1946, 41: 282.

The authors state that the infrequency of ovarian involvement in the course of Hodgkin's disease is apparent from a brief perusal of the voluminous literature of this disease. No mention of such occurrence was noted in any of several standard textbooks of general surgical and gynecologic pathology. In numerous reports of unusual ovarian tumors no instance of Hodgkin's disease was encountered. However, a closely related lesion was reported in the first 50 cases filed with the Ovarian Tumor Registry of the American Gynecological Society. A 16 year old patient had lymphosarcoma of the ovary, secondary to intestinal lymphosarcoma. A photomicrograph revealed an infiltration strikingly similar in its general characteristics to that found in cases observed by the authors. Reviews dealing with Hodgkin's disease and reports representing relatively large series of cases, as a rule, do not refer to the ovary. It is noted that other reports of autopsy observations of 112 cases of Hodgkin's disease mentioned involvement of the ovary in 2 cases. In 1 case the involvement was microscopic in character; in the other the extent of involvement was not indicated. In a report based on a study of 57 cases of Hodgkin's disease of the female it was theorized that ovarian hypofunction might have been responsible for the occurrence of the disease in women; however, no lesions of the ovary were described to substantiate this concept, which was based chiefly on the history of reduced or suppressed menstruation in several cases.

That the infiltration of the ovary in Hodgkin's disease can be of considerable extent was illustrated in 2 cases studied by the authors. In each case the lesion of the ovary was misinterpreted as a primary tumor from its gross appearance. In 1 case, the resident physician who did the autopsy submitted a gross anatomic diagnosis of carcinoma, probably primary in the ovary, with widespread secondary involvement of the abdominal lymph nodes. In the second, the surgeon, an experienced gynecologist, noted during abdominal exploration an ovarian tumor of such size that it was considered primary in that organ, while the neoplastic enlargement of the mesenteric lymph nodes was considered to be secondary to the ovarian lesion.

A discussion of the diagnosis of Hodgkin's disease in these 2 cases is presented. In the first, the lesions of Hodgkin's disease were of two types. Throughout

the abdominal lymph nodes, which were regarded as the primary site, the picture was that of Hodgkin's sarcoma, with large irregular reticuloendothelial cells spreading diffusely throughout the interstitial pulp and sinusoidal spaces and exhibiting numerous mitotic figures. Pleomorphism was particularly pronounced. The second type was that designated as Hodgkin's paraganuloma with closely spaced lymphocytic cells of mature type, containing few of the larger reticuloendothelial cells which characterize Hodgkin's disease. Both types formed the ovarian tumor. Exception may be taken to the diagnosis of Hodgkin's disease in this case inasmuch as the characteristic granulomatous reaction was not observed. Acceptance or rejection of the diagnosis depends entirely on one's opinion as to the necessary diagnostic criteria. If one accepts the broader concept of Hodgkin's disease as one with a variable pattern, subject to mutations and transitions, in which the tumor changes into the sarcomatous and almost pure lymphoid variants, which have been repeatedly described, the diagnosis in this case becomes tenable. Attention is directed to a study recently published which illustrates such variability of the histologic pattern in Hodgkin's disease.

In the second case the ovarian infiltration was obviously lymphoid in character and not consistent with the pattern of any tumor primary in that organ. The occurrence of the larger cells of reticuloendothelial type, resembling poorly developed Sternberg-Reed cells, the scattered eosinophils, and the fibrosis led to the diagnosis of lymphoblastoma, probably Hodgkin's disease. The reaction subsequently noted in the lymph node from the arm appeared to substantiate fully the original diagnosis.

That the ovarian involvement in both cases was not the result of fusion with, and direct extension from, contiguous lymph nodes was manifested by the fact that the organs were freely movable, in normal position, and unattached to the neighboring nodes, and each was surrounded by an intact ovarian capsule.

The identification of sarcomatous cells within the lumens of veins within the substance of the ovary in the first case probably serves to explain the genesis of the infiltration in this organ.

In conclusion, the authors note that in 2 cases of Hodgkin's disease with unusual involvement of the ovary the gross appearance of the lesion was such that it was misinterpreted as a primary ovarian neoplasm.

HERBERT F. THURSTON, M.D.

Rhoads, E. E.: Granulosa Cell Tumor of the Ovary. *Am. J. Obst.*, 1946, 51: 560.

A brief review of the literature is presented, with a summary of 5 cases of granulosa cell tumor. The 5 cases are summarized because of the finding of granulosa cell tumor associated with premature menopause (amenorrhea with resumption of menstruation).

All patients were operated upon. Diagnosis was made after operation on gross examination and by

# GYNECOLOGY

## UTERUS

Traino Rao, G., and Pesce, V. S.: Carcinoma of the Cervix in Relation to Age, with Particular Reference to Young Women (Il carcinoma del collo uterino in rapporto alla età, con particolare riferimento alle donne giovani). *Clin. ostet.*, 1945, 47: 165.

In a previous article the authors made an analysis of cases of cervical carcinoma treated at the Clinica di Bari from 1936 to 1943, and in this article they give their conclusions pertaining to these studies. They are as follows:

1. The number of extremely young women affected has not increased in recent years.

2. The majority of authors differentiate the carcinoma appearing in the very young as being of a particularly malignant character, but the present authors recognize no basis for this teaching.

3. In the authors' series of cases a positive family history was found more frequently in subjects attacked in early life.

4. No correlation was noted between the physical habitus and precociousness of the onset of the disease.

5. The authors' results do not indicate that pregnancy in the younger age groups acts as a contributing factor in the incidence of carcinoma of the cervix. On the contrary, among the women who had had pregnancies, cancer was apt to appear with particular promptness after parturition.

6. No correlation was found between associated disease of the genitalia or other organs and the age of the patient.

7. The time intervals elapsing between the appearance of symptoms and the admission to the clinic were found to be approximately equal in all decades.

8. Although certain characteristics of anaplasia were present more frequently in the histological picture of the younger groups, these characteristics bore no definite relationship to the clinical course, and the degree of dedifferentiation was no more marked on the whole in the youthful than in the aged.

9. Carcinoma limited to the cervix was found most frequently between the ages of 40 and 50. It might be assumed from this that the disease spreads more rapidly in women of this decade. This assumption is offset by the fact that if this group is considered together with those patients in whom the disease had invaded either the parametrium or the superior portion of the vagina, no difference could be found in the percentage of frequency up to 50 years.

10. The results of treatment of carcinoma in patients under 30 years of age were no worse than those in patients in the decades over 30. On the contrary, the percentage of survivals under 30 was higher than in the older groups or than in the entire series. In the present series results from irradiation

alone were no worse in the youthful than in the older groups.

EDITH B. FARNSWORTH, M.D.

Pereira, A. De Sousa: A Basis for Sympathectomy for Cancer of the Cervix Uteri. *Arch Surg*, 1944, 52: 260.

In recent years several attempts have been made to relieve pain in certain cancerous diseases through action on the sympathetic nervous system. By blocking the sympathetic pathways with an anesthetic solution or by surgical interruption, the fibers conducting painful sensations arising in the area involved in the neoplasia are interrupted and the painful stimulations originating in the tumoral area cannot reach the cerebrospinal centers. In this way the visceral pain of tumors located in such organs as the uterus, stomach, pancreas and breast, can be relieved.

The investigations of others suggested that the radiosensitivity of a cancer may be favorably influenced by increasing the blood supply in the tumor during the period of irradiation. This led to investigation in carcinoma of the cervix uteri to determine whether the interruption of the sympathetic innervation by anesthetic block or by sympathectomy would, in addition to reducing the pain, also increase the blood supply to that region and be useful in the irradiation of the growth. Both experimental and clinical data are presented.

The interruption of the extrinsic sympathetic innervation of the uterus at the level of the lumbar sympathetic chain (first, second, and third lumbar ganglions) and of the roots of the hypogastric plexus, besides reducing uterine pain through the physiological block of the afferent painful pathways, also caused hyperemia of the uterus by blocking the efferent vasomotor sympathetic pathways of this organ.

In different types of abdominopelvic sympathectomies in dogs, such as resection of the presacral nerve, lumbar sympathectomy, and periaortic sympathectomy, an increased arterial circulation in the organs of the pelvic cavity resulted. The higher the abdominopelvic sympathectomy the greater was this increase in the collateral circulation. In the cases of lumbar sympathectomy, an increase of the arterial circulation was also observed in the lower extremity on the same side.

In the treatment of basal cell carcinomas and adenocarcinomas of the cervix uteri, the application of radium with hyperemia of the uterus obtained by repeated lumbar anesthetic blocks induced by procaine hydrochloride, in the first, second, and third lumbar ganglions, showed that the immediate results, in observation up to a year and a half, produced a greater percentage of healing (60 per cent) of the cancerous lesions in the cervix uteri than radium alone with 47 per cent healing. The total series included 62 cases.

with vaginal plastic surgery. It should never be used as a substitute for the standard vaginal plastic procedures in use for the same purpose.

EDWARD L. CORNELL, M.D.

Ortmayer, M., Koester, L., and Stetler, P. M.: Prolapsus of a Ureterocele through the Urethra. *J. Urol.*, Balt., 1946, 55: 515.

The rarity of prolapsus of a large ureterocele through the urethra warrants the report of such a case. Only 37 instances are found in the available literature.

The case report is that of a woman of 64 years. She had noticed urinary frequency for 2 or 3 months, together with dysuria and nocturia. Recently she had noticed hematuria and incontinence. Coincidentally with the latter, she felt something protrude from the vagina on straining, which receded during sleep or on being pushed back.

On hospital admission the patient had a mild fever which subsided after a few days. Catheterized urine disclosed innumerable leucocytes in clumps, and from 10 to 12 red blood cells per high power field. A culture yielded the bacillus coli.

On cystoscopy the right half of the trigone and region of the right ureteral orifice were obscured by a large sausage shaped tumor never seen in its entirety in one cystoscopic view. It was estimated to be from thumb to walnut size, and was covered by reddish puckered mucosa. It was somewhat velvety in its right half with fibrin adherent to its tip. The tumor could be pushed from right to left, but lay toward the right bladder wall. Its base took origin just inside the internal bladder sphincter and seemed to be quite broad, occupying one-half of the trigone. The right ureteral orifice could not be located on it or in the bladder.

On external examination at the time of prolapsus, a tumor approximately 2 by 3 cm. occupied the

urethral orifice and obscured the vaginal introitus. The left half of the tumor was deep red and the right half, salmon pink. It was soft throughout. Fine, minute strands of fibrin were adherent to its tip. A dimple near the tip on its top side suggested an orifice and easily admitted a probe to 4 cm. and a No. 6 F catheter to 35 cm. without obstruction.

The cystic mass was excised and electrocoagulated with uneventful convalescence and relief from the symptoms.

Three figures are presented in the original article; they show the typical excretory urogram, a reconstructed view when the ureterocele lay within the bladder, and a colored drawing of the ureterocele when prolapsed through the urethra. A few references to the literature are added.

T. FLOYD BELL, M.D.

Couri, A. A., and Ramos, A. V.: Urogenital Endometriosis (Endometriose uro-genital). *An. brasil gin.*, 1946, 11: 27.

The authors report a case of genital endometriosis in a 35 year old woman. The condition had spread from the genital organs to the urinary tract. Suspension of the uterus and bilateral salpingectomy did not relieve the symptoms consisting of colicky pains in the hypogastrium, dysmenorrhea, and dysuria. The gynecological examination revealed an enlarged uterus and a hard nodule on its anterior aspect. The cystoscopic examination disclosed the presence of 3 elevations in the trigonum.

A subtotal hysterectomy with preservation of the ovaries was performed and the patient made an uneventful recovery. She was given a series of x-ray treatments. Cystoscopic examination performed after the operation disclosed a cicatrization of the lesions. The histological examination established the diagnosis of endometriosis.

JOSEPH K. NARAT, M.D.



histologic means, but in some cases only after microscopic examination.

Of the total of 21 cases appearing on the record, only 2 were diagnosed as granulosa cell carcinoma. Granulosa cell tumors were catalogued according to age groups, namely: (1) prepubescent or childhood, (2) adult (those within the range of normal menstruation), and (3) postmenopausal. All 21 of the cases were in the second or third groups.

One patient menstruated twice after removal of a granulosa cell tumor, and at the present time is approximately 3 months pregnant. Follow-up studies showed that all patients were living and had no evidence of recurrence.

EDWARD L. CORNELL, M.D.

DeRoux, A. G.: A Contribution to the Study of Wilms' Tumor. (Contribución al estudio del tumor de Wilms). *Arch. cubanos cancerol.*, 1945, 4: 370.

The author reports 7 cases of Wilms' tumor found in Cuba. The most constant histological features of this tumor are: (1) the epithelial tubules of glandular aspect with hyperchromatic compact masses of pseudoglomeruli; and (2) the known fibroblastic malignant tumoral aspect. He found striated muscle in 70 per cent, smooth muscle in 28 per cent, cartilage in 28 per cent, and bone in 14 per cent of his cases.

The author discusses the general characteristics of this tumor, its clinical and pathological aspects and the pathogenic theories of its production.

WILLIAM E. RICKETTS, M.D.

Kleitsman, R.: The Robert Meyer Dysgerminoma Ovarii (Zur Frage des Dysgerminoma ovarii Robert Meyer) *Acta obst. gyn. scand.*, 1946, 26: 85.

The classification of certain tumors of the ovary according to their morphologic or histogenetic characteristics only, presents insurmountable difficulties. We owe it to the work of Robert Meyer that we are able to differentiate certain tumors by their functional and incretory effects rather than by their histological structure. This holds true especially for the differential diagnosis of dysgerminoma, arrhenoblastoma, and the granulosa cell tumors.

In contradistinction to the latter two, which may exert hormonal influence (masculinization or feminization), the dysgerminoma seems to originate from embryonal cells of the ovary which have not undergone sexual differentiation, and therefore the tumor does not have any hormonal influence.

This theory is further enhanced by the fact that we frequently find the tumor in persons with pseudohermaphroditic traits, and that it occurs especially in underdeveloped gonads of both sexes. Histologically, we find undifferentiated, large, polymorphic tumor cells. The stroma frequently reveals lymphocytic infiltration, and sometimes epithelioid and giant cells of the Langhans type are found in the stroma. The tumor usually grows rapidly and may infiltrate the mesovarium, uterus, and broad ligaments. Metastases are spread more frequently by the lymph than

by the blood circulation. The retroperitoneal lymph nodes are usually involved at an early stage.

The author discusses 3 cases which were observed at the Gynecological Hospital, Stockholm. One patient could not be operated upon radically because of metastases and was given postoperative radiation: she died 2 years after an operation on the metastases. The second patient, from whom both ovaries were removed, was not given radiation therapy; she is still in good condition after 6 years. The third patient, from whom a dysgerminoma on the right side, twice the size of a man's head, was removed, has undergone three pregnancies and is healthy 5 years after the operation.

WERNER M. SOLMITZ, M.D.

## MISCELLANEOUS

Aldridge, A. H.: An Evaluation of Methods for the Treatment of Urinary Incontinence. *Am. J. Obst.*, 1946, 51: 299.

Urinary incontinence may be due to fistulous communications between the urethra, bladder, or ureters and the vagina or uterus. However, the most frequent cause for loss of urinary control is incompetence of the urethral sphincter mechanism which controls urination.

Of the series of 118 urinary fistulas that has been reported, approximately one-third were caused by obstetric trauma, about one-half by surgical trauma, and 15 per cent by malignant neoplasms of the uterus, alone or in combination with irradiation used in treating such tumors.

Success in the treatment of a urinary fistula will depend upon careful preparation of the patient for operation (elimination of urinary infection, inflammation of the adjoining tissues, and anemia), accurate localization of the fistula, and the selection of a technique best suited to conditions found before and at the time of operation.

Repair of a fistula by a technique which depends upon denudation of its margins should never be attempted unless closure can be accomplished without undue tension on the surrounding tissues.

Flaps developed for closure of a fistula should be made up of the entire thickness of the vaginal wall to insure an optimum nerve and blood supply. The importance of closing a fistula on the first attempt is obvious. Every surgical failure decreases the chance for ultimate success.

Vaginal plastic procedures are successful in curing from 80 to 90 per cent of the patients who have urinary incontinence due to relaxation or partial destruction of the urethral sphincter muscles.

If function of the urethral sphincter muscles cannot be restored by vaginal plastic procedures, an attempt to establish urinary control by transplantation of adjacent muscles and fascia should be considered. A technique for this purpose recently described has been successful in 9 of 10 cases operated upon by 3 gynecologists.

As a means of relieving urinary stress incontinence, transplantation of fascia should always be combined

cause of the hydremia factor, or they may even give a false clue to diagnosis. Sternal marrow biopsy then becomes mandatory.

The normal erythroid marrow findings noted in healthy patients during pregnancy are conclusive in revealing that the lowered peripheral blood levels are due only to a hydremia, and speak for normal findings during pregnancy associated with blood dilution.

The characteristic marrow pattern noted in the various blood dyscrasias is of diagnostic, prognostic, and therapeutic importance in the management of both the hematological and obstetric problems.

One of the greatest values of sternal marrow biopsy is its negative value. The finding of a normal type of bone marrow definitely rules out the presence of a primary blood disease. The only exception is in cases of aleucemic lymphadenosis. (Lymph node biopsy will be needed.)

EDWARD L. CORNELL, M.D.

Costa, N. P., Chavanne, F. C., and Fernández, O. Z.: Hodgkin's Disease and Pregnancy (*Enfermedad de Hodgkin y embarazo*). *An. Ateneo Inst. maternidad*, 1945, p. 127.

This article discusses 5 cases in which pregnancy was complicated by Hodgkin's disease. The patients were subjected to radiation therapy which apparently had no ill effects on the fetus.

The patient who prompted a review of the 5 cases was a primigravida, 23 years old, who developed a swelling in her neck during the first month of pregnancy. The swelling gradually increased in size until it surrounded the entire neck. A biopsy was performed and the diagnosis of Hodgkin's disease was made. Radiation treatment was given which reduced the swelling perceptibly.

The 4 other cases of Hodgkin's disease were briefly reviewed, and it was concluded that radiation treatment was a valuable aid to the pregnant patient with Hodgkin's disease. STEPHEN A. ZIEMAN, M.D.

## LABOR AND ITS COMPLICATIONS

Chimienti, P.: Cesarean Section for Epilepsy in Pregnancy (*Cesarea por estado de mal epileptico en el embarazo*). *An. Ateneo Inst. maternidad*, 1945, p. 159.

The author discusses in detail the clinical course of a woman who suffered epileptic attacks several days prior to the onset of labor. After 7 hours of trial labor with no dilatation of the cervix and no advancement, the baby being alive, cesarean section was resorted to with surprising success. The postoperative course was complicated, however, with two new convulsive seizures. The therapeutic management consisted in saline and dextrose infusions. The patient recovered promptly and suffered no further attacks.

In discussing epilepsy, Chimienti describes the symptomatology and the differentiation between true epilepsy and hysteria. He divided the symp-

tomatology of true epilepsy into the aura period, the convulsive period, and the postepileptic state.

The article is concluded with briefs of some 43 case histories of pregnancy complicated by true epilepsy. The epilepsy in no perceptible way altered the course of the pregnancy, although a grave prognosis is given both for the mother and child.

STEPHEN A. ZIEMAN, M.D.

Speiser, M. D., and Speck, G.: An Evaluation of the Treatment of the Persistently Unengaged Vertex in the Multipara. *Am. J. Obst.*, 1946, 51: 607.

Although this series is not large, it presents significant facts which must not be overlooked; namely, a corrected fetal mortality of 38 per cent and a maternal mortality of 9.5 per cent. Careful scrutiny reveals the fact that version and breech extraction per se cannot be condemned, because in 9, or 42.9 per cent, of the cases in which no other complications existed, satisfactory results were obtained. There is a tendency, however, to perform version and breech extraction without a thorough investigation of the causes for the persistent lack of engagement, which factors may be contraindications for this procedure.

In this series, it was found that among the 12 cases with disastrous results, 6 patients had cephalopelvic disproportion. Delivery by version and breech extraction was accomplished with difficulty and resulted in stillbirths with definite evidences of birth injuries. Unfortunately, an accurate appraisal of the size of the baby by clinical means is not always easy, especially in a multipara with an obese, pendulous abdominal wall. In addition, one usually seems less concerned in this type of patient after obtaining a history of spontaneous deliveries of moderately large babies. However, in those instances in which successive pregnancies are associated with progressively larger babies, the point may finally be reached when a baby may be too large to come through a pelvis which was adequate for previous infants.

During the 10 year period from 1933 to 1943 there were 27 cesarean sections performed after the onset of labor on multiparous patients in whom there was persistent lack of engagement of the vertex and in whom there were cephalopelvic birth injuries (intracranial hemorrhage and tear of the falx cerebri) after a 9½ hours' labor with ruptured membranes for 5½ hours. There were no maternal deaths in this group.

The failure to recognize cephalopelvic disproportion accounted for 50 per cent of the fetal deaths. In the presence of failure of engagement in the multipara, therefore, version and breech extraction should not be performed unless there is absolute proof that no disproportion exists.

The presence of a residual rim of the cervix may be a very definite hazard in the performance of a version and breech extraction. Version may be safely executed but the breech extraction must be deferred until the cervix offers no obstruction.

Upon recognition of cephalopelvic disproportion, cesarean section is the procedure of choice.

EDWARD L. CORNELL, M.D.

# OBSTETRICS

## PREGNANCY AND ITS COMPLICATIONS

Virgili, C.: Clinicostatistical Considerations Based on 128 Cases of Extrauterine Pregnancy (Considerazioni clinico-statistiche su 128 casi di gravidanza extrauterina). *Riv. ital. ginec.*, 1943, 26: 400.

During the 6 years from 1936 to 1942, 128 cases of extrauterine pregnancy came to operation. This represented 3.05 per cent of the total admissions to the gynecological department, and 3.72 per cent of the patients coming to operation. In this period there was very little seasonal or yearly variation. The age period from 28 to 30 years showed the greatest incidence of this condition, the graph falling sharply away from this culmination toward the two extremes of the sexual period of woman. Forty-two and twelve hundredths per cent of this material consisted of nulliparous women, and 57.88 per cent of pluriparous; of the latter 48.6 per cent had had one previous pregnancy, 20 per cent had had 2 pregnancies, and 17 per cent had had 3.

Ancillary signs of pregnancy, such as vomiting, amenorrhea, enlargement of the uterus, softening of the cervix, are either insignificant or at least not as constant and characteristic in extrauterine pregnancy as in normal pregnancy; however, when evidence of extrauterine pregnancy is present, such matters become of import—even a delay of 1 or 2 days in the appearance of bleeding beyond the presumptive menstrual period assumes significance. Pain is a constant symptom of extrauterine pregnancy; however, the sign may be intermittent, or absent for weeks at a time, and even if present it must be evaluated properly with reference to other symptoms. A rise of temperature to 38° C. is not uncommon and should not divert attention from the possible presence of extrauterine pregnancy. If doubt still persists there is not much harm to be anticipated from a uterosalpingography or aspiration of a hematoma within the abdomen.

At operation on these cases signs of a previous pelvic infectious process were found in 1 of 3 patients. In occasional patients other pathological conditions such as ovarian cysts and uterine fibroids were also encountered, all presumably capable of causing the extrauterine abnormality but not necessarily doing so. However, once the extrauterine pregnancy is recognized, the only procedure is surgical.

In the author's material adnexectomy was done on the right side in 32 per cent of the cases, on the left side in 29.6 per cent, and bilaterally in 14.80 per cent; subtotal hysterectomy was added in 12.5 per cent of the cases. Any attempt to save the adnexa on the opposite side depended on their condition and to a lesser extent on the patient's condition and needs with regard to parity. Recurrence in the opposite tube was encountered in 3.9 per cent of the cases. The operative mortality was 1.56 per cent.

The author believes that intrauterine pregnancy compromises the chances of the patient acquiring a later pregnancy. He cites the fact that in 11 of the women in his material a later salpingographic examination showed that the remaining tube was occluded; however, he believes that this may in many instances have been the result of conditions preceding the surgical intervention.

JOHN W. BRENNAN, M.D.

Redell, G.: Parathyroprival Tetany and Pregnancy. *Acta obst. gyn. scand.*, 1946, 26:1.

On the basis of the literature and the study of 4 cases the author believes that in case of postoperative tetany the patient should be informed that if she becomes pregnant it is imperative that a series of serum calcium determinations be made frequently.

It is known that the serum calcium level often drops in pregnancy, and the calcium has been known to decrease as early as the third month. It is also known that the follicular hormone decreases the calcium content of the blood. Therefore it should be borne in mind that during pregnancy one must be on the watch for an exacerbation of tetany.

In 2 cases described the patients became pregnant during periods when they showed signs of tetany. In both of them the pregnancy, delivery, and puerperium were uneventful. In the other 2 cases the condition was less severe and here again there were no complications. There was no mention of the fact that calcium therapy was or was not used during the prenatal course.

CATHERINE B. HESS, M.D.

Wolff, J. R., and Limarzi, L. R.: Blood Disorders Associated with Pregnancy. *Am. J. Obst. Gyn.*, 1946, 51: 447.

In the past the obstetrician's main interest in the blood findings associated with pregnancy has been in the clinical interpretation of the commonly noted lowered hemoglobin level and erythrocyte count seen in healthy individuals during pregnancy. In more recent years, the association of pregnancy and the various blood disorders has gained attention, but unfortunately no use has been made of the sternal marrow findings. The hematologist, likewise, has not yet considered the problems of pregnancy in the light of the information obtained from bone marrow studies. It is only through co-operation of the hematologist and the obstetrician that such a relatively new idea can reach its proper place in clinical investigation.

Bone marrow biopsy is not the sole method or answer to hematological diagnosis. It is merely a part of the diagnostic "blood work-up," but it is an important one. The standard peripheral blood studies are still of major importance, and in many cases the sternal marrow findings may be only confirmatory. Yet peripheral blood studies, especially in pregnancy, often do not give sufficient information be-

# GENITOURINARY SURGERY

## ADRENAL, KIDNEY, AND URETER

Sandrini, G.: A Case of Supernumerary Megaureter (Un caso di megauretere soprannumerario). *Riforma med.*, 1946, 60: 7.

The author reports the case of a 4 year old female child who was admitted to the hospital with pain and tenderness in the right lower quadrant, obstipation, rapid pulse, and elevation of the temperature. Laparotomy revealed an anomalous second ureter on the right side which grossly resembled a loop of small intestine, but was connected with the pelvis of the kidney and showed a sphincterlike ureterovesical orifice. The structure was found to be distended with purulent urine.

Microscopic examination showed three muscle layers lined with mucosa similar to that of the bladder and covered with a serosal layer. Since the kidney was otherwise normal, surgery was confined to the removal of the anomalous ureter, and the patient left the hospital after an uneventful recovery.

The gross and microscopic morphology of the lesion are carefully described and the derivation is discussed

EDITH FARNSWORTH, M.D.

Hellström, J., and Romanus, R.: UreteroIntestinal Implantation According to Coffey. *Acta chir. scand.*, 1946, 93: 439.

While interest in ureteral implantation in the intestine has been great, especially in America, and has given rise to a copious literature, this operation seems to have been relatively little resorted to in the Nordic countries and has been the subject of only brief reports.

The material derives from the Surgical Clinic of Karolinska Sjukhuset during the period from February 1, 1940 to November 15, 1945, and comprises 45 patients, 23 male and 22 female, ranging from 4 to 78 years of age. Altogether 89 ureters have been implanted according to Coffey's method I. Of these, 4 have been reimplanted; on 2 occasions double ureters have been implanted simultaneously; in 4 cases it was a matter of single kidney, and in 3 cases only unilateral implantation has been carried out; the operation was not completed because of the progress of the malignant process. (Since the material has been collected a further 3 patients with cancer vesicae have been operated upon for ureteral implantation, in 2 cases after cystectomy, and in 1 case in which the bladder was not removable.)

On the whole the cases may be classified in two groups; namely, (1) congenital or acquired states of the bladder, with complete incontinence or very frequent and painful urination, and (2) primary or secondary tumors of the bladder that can only be treated radically by cystectomy, or tumors for which ureteral implantation is indicated as a palliative measure.

Ureteral implantation according to Coffey's first method is an operation which, when performed with the right technique, is combined with a very low primary operative mortality.

In all of the cases except 2 the implantations have been performed in 2 stages, as a rule with the procedure commencing on the right side. Ureteral dilatation, even when very pronounced, has not been regarded as a contraindication, but rather as the opposite.

In no case has peritonitis or serious wound infection arisen. Four patients—all suffering from cancer vesicae—have died in the hospital, 2 of the original disease, and 1 patient each of rectal injury in connection with the cystectomy and of pyelonephritis. Thirteen patients have died after discharge, 8 of the original disease (cancer) and the others more or less because of the ureteral implantation which led to infection and dilatation of the ureters and pelvis. Infection and dilatation with impaired renal function had often existed, however, before the implantation. By means of repeated excretory urographies it was found that the dilatation of the ureters and pelvis which, as a rule, appears after the implantation generally recedes more or less completely later on. The condition of the survivors was good in 17, satisfactory in 9, and poor in 2 cases.

In certain cases, however, because of dilatation and infection, renal insufficiency which may have a fatal issue arises. On account of this and the discomfort of more or less frequent evacuations of the bowel which occur in a number of patients, ureteral implantation must be regarded as a serious operation that should be resorted to only when it is definitely indicated.

According to the author's own experience and to the data given in the literature, the ureteral implantation according to Coffey method I does not give worse, but rather better immediate and final results than other methods for ureteral implantation in the intestine, which as a rule are more complicated.

JOHN E. KIRKPATRICK, M.D.

Young, W. W.: Sclerosing Injection of Polycystic Kidney following Surgical Exposure. *J. Urol.*, Balt., 1946, 55: 343.

It is generally admitted that radical surgery, such as nephrectomy, is to be condemned except in rare instances. The pathological change in polycystic kidney warrants only a minimum of surgical trauma. The object of specific surgical treatment is to make room for renal parenchymal tissue with its vascular supply, which is being compressed and atrophied by multiple cystic intrusion.

When the patient, whose case history is presented below, required surgical intervention because of pain from unilateral cystic distention, it occurred to the author, although puncture and evacuation might

## MISCELLANEOUS

Davis, M. E., and Gready, T. G., Jr.: A Review of the Maternal Mortality at the Chicago Lying-in Hospital, from 1931 to 1945. *Am. J. Obst. Gyn.*, 1946, 51: 492.

Great strides have been made during the past 15 years in the reduction of maternal deaths during childbirth. The curve is still continuing downward as the irreducible minimum has not been reached. The great improvement in the obstetric field is the result of many factors; the education of the profes-

TABLE I.

Deliveries in the hospital . . . . .	39,719
Deliveries in the home . . . . .	6,701
Abortions managed in the hospital . . . . .	1,738
Ectopic pregnancies . . . . .	132
Total number of pregnant patients . . . . .	47,945
Total deaths . . . . .	81 or 0.17%

TABLE II

Delivered and died in the hospital . . . . .	64
Delivered in the home and died in the hospital . . . . .	11
Delivered by home service or C.M.C . . . . .	9
Delivered by private physicians . . . . .	2
Delivered and died on home service . . . . .	3
Delivered in hospital but died at home . . . . .	2
Sent from home service to Cook County . . . . .	1
Total number . . . . .	81
Maternal mortality . . . . .	0.17%

TABLE III

## Age (Years)

Average age . . . . .	29.4
Oldest patient . . . . .	43.5
Youngest patient . . . . .	15.0

## Duration of Pregnancy

More than 36 weeks . . . . .	51
From 30 to 36 weeks . . . . .	11
From 20 to 29 weeks . . . . .	9
Under 20 weeks . . . . .	1

Criminal abortion . . . . .	3
Ectopic gestation . . . . .	1

sion, the education of the lay public, better hospital facilities, and, most important, the dramatic advances that have taken place in the practice of medicine.

There were 81 deaths among 47,945 obstetric patients, an over-all mortality of 0.17 per cent of all pregnant patients.

The causes of death in the 81 women are listed as follows: genital infection, 23.5 per cent; extragenital infection, 16 per cent; heart disease, 16 per cent; hemorrhage and shock, 16 per cent; toxemia of pregnancy, 7.4 per cent; pulmonary embolism, 7.4 per cent; transfusion reactions, 3.7 per cent; miscellaneous (air embolism, Steiner's disease, agranulocytic angina), 3.7 per cent; anesthesia, 2.5 per cent; hyperemesis gravidarum, 2.5 per cent; and spinal anesthesia, 1.3 per cent; All of these causes are discussed in detail.

EDWARD L. CORNELL, M.D.

# GENITOURINARY SURGERY

## ADRENAL, KIDNEY, AND URETER

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**Young, W. W.: Sclerosing Injection of Polycystic Kidney following Surgical Exposure. *J. Urol.*, Balt., 1946, 55: 323.**

It is generally admitted that radical surgery, such as nephrectomy, is to be condemned except in rare instances. The pathological change in polycystic kidney warrants only a minimum of surgical trauma. The object of specific surgical treatment is to make room for renal parenchymal tissue with its vascular supply, which is being compressed and atrophied by multiple cystic intrusion.

When the patient, whose case history is presented below, required surgical intervention because of pain from unilateral cystic distention, it occurred to the author, although puncture and evacuation might

prove adequate for a brief period, an effort should be made to prevent the reformation of cysts, if possible. It seemed logical to instill a mild sclerosing agent into the emptied cystic cavities. Five per cent sodium morrhuate solution was selected.

Fish has reported 2 cases of solitary cyst of the kidney cured by aspiration and the instillation of 50 per cent dextrose solution; but as far as a careful search of the literature reveals, this type of procedure has not been proposed for polycystic kidneys.

A girl, aged 15, was first admitted to the hospital for urinary investigation following the discovery of palpable masses in both renal regions by her family physician. Intravenous pyelography a few days prior to admission revealed: "both kidneys equally enlarged with large pelvis of a similar shape, that is, the lower calyces have a normal contour but are slightly enlarged. The upper calyces are larger and show a tendency to concave pressure deformity. The appearance, however, is not entirely characteristic of cystic kidney (the kidneys have a smooth contour). The ureters are quite small and both make a right angle curve as they enter the pelvis. Excretion of dye was apparently normal. Conclusion: Probable congenital polycystic kidneys."

In the upper left quadrant a large mass could be palpated which extended down to the level of the iliac crest. This had a smooth, firm, elastic surface and the contour of a large kidney. In the right upper quadrant a similar mass, not quite as large, extended to a level just above the crest of the ilium. Both masses were fairly mobile. The nonprotein nitrogen was 38 mgm. per 100 c.c. of blood. The 2 hour phthalein output was 43, 17, 5, and 3 per cent or a total of 68 per cent.

Bilateral retrograde pyelograms, including a lateral view, demonstrated definite distortion of the enlarged, elongated calyces due to concave or "crescentic" defects in both kidneys. The upper major calyces appeared markedly narrowed compared with the minor calyces beyond. The diagnosis of congenital polycystic kidneys was established.

The patient failed to return for observation until about 21 months later. When she entered the office, her general physical contour suggested a full term pregnancy. In order to obtain any relief at all she had to remain in a recumbent position.

Physical examination again revealed all clinical abnormalities confined to the abdomen except for the blood pressure which was now 170-90. The entire left side bulged prominently, especially in the left lower quadrant. The abdominal wall was soft except over the large, immobile mass which completely filled the left side, extending from above the rib margins to and below the pubic ramus and symphysis. The surface of this mass was generally smooth, firm, and elastic with minor lobulations. There was slight tenderness over the whole mass when moderate pressure was exerted but there were no localized areas of acute tenderness. On the right, the findings were essentially similar to those noted on the previous examination. The right kidney ex-

tended down to just about the iliac crest, and, apparently, had proportionately grown no larger.

Cystoscopy was repeated. Fifteen minute differential phthalein output from the left kidney was as follows: appearance time, 13 minutes; excretion, 2 per cent; right kidney, appearance time, 11 minutes; excretion, 6 per cent.

Under general anesthesia, the left kidney was exposed through an oblique lumbar incision extending to just above the anterior superior spine. Before leaving her bed and again after the anesthesia had been administered, the patient received 5 c.c. of 8 per cent indigo carmine intravenously. The perirenal fat was minimal. On the grayish red surface of the hugely enlarged kidney there were numerous large, well demarcated cysts under considerable tension and a variety of smaller cysts of all sizes. The kidney was mobilized as freely, gently, and as completely as necessary for ample surface exposure. The lower pole protruded for a short distance into the true bony pelvis. With a large supply of Luer syringes, ranging from 10 to 50 c.c. in size, and a variety of needles ranging from 22 to 17 gauge, with both sharp and blunt bevel, aspiration and instillation of the individual cysts were undertaken. The aspirated fluid was turbid and grayish brown in color. It approximated the consistency of milk and passed readily through a 20 gauge needle. The cysts were evacuated as completely as possible, this being facilitated by gentle manipulation or pressure in various directions on the surface of the kidney.

Superficial cysts were observed to collapse so that deep concavities formed on the renal surface. As much as 70 c.c. of the fluid contents were obtained from each of several of the larger cysts. After aspiration of each of the larger individual cysts, the needle was held in place, the syringe detached, and another containing 5 per cent sodium morrhuate solution for instillation was applied. Many of the deep seated cysts were located easily by palpation although they were not discernible on the surface. On two or three occasions, the needles were inserted into the renal pelvis and essentially clear, light bluish green urine was obtained, substantiating the value of the preliminary use of indigo carmine. A total of 35 c.c. of sodium morrhuate solution was used, the quantity for each cyst varying with its size and the amount of fluid aspirated. Approximately 1 c.c. of solution was instilled for every 10 c.c. removed. Many of the smaller surface cysts were aspirated without injection, or they were simply punctured.

The kidney changed noticeably in size and conformation, diminishing from two-thirds to one-half of its original mass. The surface became flabby and loose. After the insertion of two small cigarette drains, the incision was closed in the usual manner with chromic catgut and silk sutures.

The postoperative course was uneventful. The temperature rose as high as 102.2°F. rectally during the first 4 days and remained normal after the fifth day. The patient had no more pain or greater discomfort than usually is experienced after renal

surgery. The incision remained uninfected and healed essentially per primam.

During the next 9 months the patient was observed personally on infrequent occasions. She soon returned to school and to her normal activities, being completely asymptomatic. The large left kidney, now much smaller than in its preoperative state, assumed a roughly spherical shape, causing moderate protrusion of the upper left abdomen; the lower pole reached a level just below the iliac crest. On November 14, 1941, the nonprotein nitrogen was 33 mgm. per 100 c.c. of blood and the 2 hour phthalein output was 14, 20, 14, and 10 per cent, a total of 58 per cent. Urinalysis was essentially normal except for a trace of albumin. The blood pressure was 140-90.

JOHN A. LOEF, M.D.

**Nyström, T. G.: Rupture of Kidney Tumors and Hydronephroses. *Acta chir. scand.*, 1946, 93: 513.**

The author reports 2 cases of rupture of the kidney, a rare complication, occurring in a case of (1) hypernephroma and (2) hydronephrosis.

In the former case, the patient was a woman aged 51, who had been treated for hypertension and "kidney trouble" for 2 years before hospitalization because of a fall in the street, at which time she knocked her left side against the pavement edge. The admission diagnosis was possible ruptured spleen. The physical findings were temperature 37.1°C. (pr) and pulse 72. She was quite pale and presented considerable tenderness in the left upper quadrant, where an indistinct mass was felt. The urine revealed both albumin and microscopic blood particles. Exploratory laparotomy revealed a normal spleen, slight hemoperitoneum, and a distended left renal sinus with an enlarged, nodular kidney. The nephrectomy findings were: a renal sinus filled with fluid blood, clots, and pieces of tumor tissue and a kidney the size of a child's head. There was no extension of the tumor into the renal vein. The pathological diagnosis was Grawitz's tumor. (The patient died 6 months after operation, from generalized metastases.) Study of the operative specimen showed that the tumor had grown outward, penetrating the capsule and then breaking into the renal sinus; penetration into the pelvis or calyces had not occurred, which explained the absence of macroscopic hematuria.

The second case was that of a soldier, aged 23, whose first hospital visit in September, 1942, because of hematuria, revealed hydronephrosis on the left side with a question of periureteritis. In July, 1943, while pole vaulting, he disregarded back pains in the region of the left kidney and continued vaulting until the sudden onset of an intense, tearing pain in the back. Field hospital examination revealed marked tenderness, with slight muscle spasm in the left costovertebral angle. The urine was grossly bloody. Because of a relapse the day after admission, with an increase in the intensity of the symptoms nephrectomy of the left kidney was done. The operative findings were: a renal sinus filled with fluid

blood and clots; the renal parenchyma measured about 1 cm. in thickness, the remainder of the kidney being a flabby, thin walled sac, containing fluid blood and clots, with a tear about 6 cm. long in its posterior wall. An aberrant artery was found, passing anteriorly over the ureteropelvic junction from the anterior surface of the lower pole of the kidney. There was no evidence of a periureteritis. The patient recovered and was returned to duty.

In a discussion of the factors involved in the clinical picture of rupture of a hydronephrosis, the following are considered:

1. Incidence, age, sex. Up to 1934, only 70 cases were reported. Although hydronephrosis is more common on the right side, ruptures occur twice as often in cases of hydronephrosis on the left side, probably because of the more exposed location of the left kidney. In a review of 70 collected cases, it was found that 44 occurred in patients between the ages of 10 and 40, and the patients more frequently were males.

2. Type of rupture. The cases were divided into: (a) partial ruptures which may heal or may develop into secondary traumatic cysts, and (b) total ruptures which were classified as: (1) ruptures extending to the capsula fibrosa, with a resulting perirenal pseudohydronephrosis; (2) ruptures including the capsula adiposa, resulting possibly in a pararenal pseudohydronephrosis; and (3) ruptures in which there is a single layered sac wall and the rupture extends out into the renal sinus retroperitoneally. The last is the most common type. In a few cases, the hydronephrosis was closely adherent to the peritoneum. One case of hydronephrosis rupturing into the cecum is reported.

3. Mechanism by which rupture occurs. When a hydronephrosis ruptures, the provoking trauma is often slight (as in a case in which rupture occurred when the patient jumped in bed). The rules applying to ruptures of internal parenchymatous organs also apply to cases of hydronephrosis. Most ruptures result from either compression or angulation. In the case of the former, the line of rupture is similar in direction to that of the applied force; in the latter instance, it is at an angle to the line of force. Compression of the hydronephrotic cyst from above downward will produce ruptures either in the anterior or posterior wall; compression from side to side or from the front in a backward direction will produce a rupture in the superior or inferior portion of the cyst. A rupture due to compression is more common than one due to angulation. Most authors maintain that the rupture of hydronephrotic cysts usually occurs in the posterior wall of the cyst and often in the inferior pole of the renal pelvis, especially after falls from a height.

The mechanism of rupture in the second patient is described by the author as follows:

In a pole vaulter, intra-abdominal pressure is increased as the athlete runs forward, with coincident increases of pressure within the hydronephrosis. As the body is swung up to clear the rail, it rotates



on its long axis and the kidney falls forward; as the psoas muscle and the vertebral column prevent it from swinging backward, the organ also rotates in a forward direction. If the ureter is fixed in abnormal contact with the pelvis, as is said to occur in most cases of hydronephrosis, this fixation will result in torsion because of the rotation; the pelvis cannot empty and a state of acute retention arises. As the jumping continues, the renal pelvis becomes more dilated with resulting increase in cyst tension until eventually compression occurs as the patient falls to the ground, and rupture of the hydronephrosis occurs. This would explain the pain felt by the patient as he continued to jump.

4. Symptoms. These depend on the type of rupture which has occurred. Commonly, there is a history of trauma to the abdomen or back, followed by a rapidly developing tumor in the region of the kidney, or there may be a renal enlargement, already in existence as a result of previous trauma, which also enlarges quickly following a second insult. Signs of peritonitis often predominate in some patients, in whom there is neither tumor nor hematuria because the hydronephrotic cyst which adheres to the peritoneum has ruptured directly into the peritoneal cavity. In some patients the acute symptoms subside, to be followed by pain after a somewhat asymptomatic period, which is indicative of a slowly developing tumor. Hematuria is not commonly found in cases of ruptured hydronephrosis; this is a result either of a tear through a nonparenchymatous area, or of retroperitoneal extravasation with associated ureteral compression. The statement that ruptured hydronephrosis has resulted in fatal reflex anuria is countered with the suggestion that the outcome was due rather to the fact that hydronephrosis, so often bilateral, had left an amount of kidney tissue incapable of secreting sufficient urine to maintain life.

The differential diagnosis includes consideration of ruptured spleen, renal calculus, ruptured ectopic pregnancy, and torsion of an ovarian cyst, and when there is a generalized peritonitis, only the history, if it is fairly typical, can suggest the etiological agent.

EUGENE J. AUDI, M.D.

### BLADDER, URETHRA, AND PENIS

Pickerill, H. P., and Pickerill, C. M.: Ectopia Vesicae. *Austral. N. Zealand J. Surg.*, 1945, 15: 91.

Ectopia vesicae or exstrophy of the bladder is probably the worst and most distressing congenital malformation which afflicts human beings. Its frequency has been placed at about 1 in 50,000 births.

The most important defect is undoubtedly the osseous one. The pubic bones fail to unite, and each rectus muscle, being attached to the end of a pubic bone, is widely separated from its fellow below, which leaves a large triangular defect in the abdominal wall. The anterior wall of the bladder fails to join in the midline and the skin also fails to unite; the margins of the bladder unite instead with the external skin at each side. If the subject is a male,

there is always an accompanying complete epispadias.

To those having to deal with this surgical condition, it has seemed obvious that the first step must be to get the pubic bones to approximate one another in order to bring the recti together, and many attempts have been made toward this end, but without a single success by any surgeon, so far as can be ascertained.

In recent years implantation of the ureters into the bowel has been practiced so widely for other conditions that genitourinary surgeons have claimed that almost all patients with ectopia vesicae should be treated similarly. With the increasing development of the transplanting operation an easy way out of the difficulty is offered; but the authors want to make sure that this is the best for the patient in the long run. At least since Young's epoch-making operation, this method warrants serious consideration in every case. If this operation can be perfected so that urinary control can be relied upon definitely, then there will be no question as to the right method of treatment. However, if the operation fails to give control, is it still worth while? The authors think the answer is definitely "yes." In the male it is a difficult and prolonged procedure, but it gives results in that it can restore a patient to social circulation with surprisingly little disability.

If transplantation of the ureters is done, it still leaves the bladder and, in the male, the epispadias to be dealt with. If the bladder is left it is exposed to much superficial irritation, which eventually in a considerable number of cases (30%) causes malignant changes. The bladder must either be removed or closed by plastic operations. If it is excised as some surgeons recommend, what is to be done about the epispadias, remedy of which would then be practically impossible? Amputation of the penis has been suggested. The authors regard this as an unjustifiable mutilation. In addition, the possibility that the transplantation on one or both sides may not be successful must be taken into consideration. The results depend apparently upon the type of operation chosen and the skill and experience of the surgeon. There is, too, always the continuing risk of an ascending pyelitis, although it is claimed that this is a diminishing one.

There is the further consideration, of great importance in the authors' opinion, of the psychological effect on the patient of the persistence of an ugly irritable disfigurement or other obvious defect of the genital region, which has at all costs to be kept secret.

The authors discuss 2 cases treated satisfactorily by the Young operation. JOHN A. LOER, M.D.

Mullenix, R. B.: Cystometry in the Study of Traumatic Neurogenic Bladder. *J. Urol.*, Balt., 1946, 55: 479.

A factual report of experience in the management of neurogenic bladder secondary to war wounds may be of value in the further study and solution of this vexing problem in civil life.

For a period of several months the author worked in association with the staff of an active neurosurgical center. During this period a large number of injuries of the spinal cord and cauda equina were cared for, under a stringent short term evacuation policy. In most instances tidal irrigation was not employed in this installation, suprapubic cystostomy having been performed when the intractability of the bladder dysfunction had been positively demonstrated. The final positive proof of intractability is, of course, the continued inability to void satisfactorily following the removal of the urethral catheter. Simple and positive though it may be, this method of trial has not infrequently been followed by ascending urinary infection with severe febrile reactions.

A preliminary appraisal of bladder function has been of value in preventing the subsequent occurrence of this complication. In an attempt to predict the ability or inability of the individual patient to void, cystometric studies were made in a large number of patients, an estimate of bladder function was arrived at, and the prediction was then proved to be correct or incorrect by actual trial without catheter. It has been possible to predict accurately the outcome in a high percentage of these patients, insofar as the time allowed for observation in this hospital would permit, and to plan treatment on this basis. The value of cystometry in the civil practice of urology has been controversial. Although the author has no desire to enter this controversy, cystometry in his hands has been of great value in outlining the management of a large number of cases of neurogenic bladder due to wounds of the spinal cord and cauda equina. The usual technique of performance of cystometry has been expanded to yield more information regarding bladder dynamics and to visualize these findings graphically.

At the present time, repeated cystometric study is the most important diagnostic aid in the urologic study of the neurogenic bladder, and provides a permanent graphic record of progress over a long period of time. It may be helpful in the differentiation of bladder dysfunction based on neurogenic and obstructive changes. This may be particularly true in the appraisal of operative results in patients in whom both neurological and obstructive pathological changes may be coexistent or suspected. The many limitations of the procedure are also recognized.

This discussion and accompanying statistical data are presented with the full realization that they represent a small part of the problem of the neurogenic bladder. Periods of observation have been short, although the complete cycle of neurophysiological adjustment is very long.

The treatment of cord bladder, as such, is not strictly within the intended scope of this paper and has been referred to only briefly. The régime employed in this theater has been evolved on a basis of the requirements and limitations of the military service and has made possible the transportation and final definitive care of the largest possible number of patients.

JOHN E. KIRKPATRICK, M.D.

Williams, S.: Nongonococcal Urethritis in Australian Troops Stationed in Borneo. *Med. J. Australia*, 1946, 1: 693.

From 45 to 60 per cent of the cases of urethral discharge among Australian soldiers, in 1942, were of nongonococcal urethritis. Cases of nonspecific urethritis were then found wherein intracellular inclusion bodies were demonstrated in the urethral smears. Some workers were also able to culture pleuropneumoniae-like organisms from the normal male urethra, from cervix uteri, and in 20 per cent of a series of nonspecific cases of urethritis in men. In view of these reports, a routine examination for inclusion bodies was made in all cases of nongonococcal urethritis at a military hospital in North Queensland, which revealed 8 instances of such bodies among the first 34 cases examined. When it was found later that nonspecific urethritis was occurring among troops stationed in the Netherlands East Indies, whose only contact was with the local Indonesians and Chinese population, it became of interest to see whether inclusion bodies could be demonstrated here also. The subjects investigated were Australian soldiers who had contracted their infection in widely separated areas in Borneo and had been evacuated to Morotai for nonmedical reasons.

Clinical features of these cases were: an incubation period of from 1 to 4 weeks; a thin purulent discharge, often present only in the mornings and persisting for from 7 to 20 days; an absence of dysuria or other symptoms; and lack of response to either sulfonamide or penicillin therapy. Altogether, 19 patients were examined, and in 10, typical inclusion bodies were found in the smears.

Laboratory findings, with Leishman's stain, revealed inclusion bodies in varying numbers. The bodies stained a bluish-purple, showing up clearly in the pale blue cytoplasm of the cells. They appeared as tiny, discrete, ovoid or rod-shaped particles arranged in small masses or clusters in the cytoplasm of large epithelial cells. They were never found in the leucocytes or in smaller epithelial cells; intranuclear forms were not observed. (Smears were obtained by introducing a platinum loop into the urethra and gently scraping cells and exudate from the mucous membrane).

On close inspection, inclusion bodies were found to have a characteristic morphology which differentiated them from the rickettsiae seen in murine and scrub typhus and from the elementary bodies of the psittacosis and lymphogranuloma inguinale group of viruses. The bodies are from 0.3 to 0.5 micra in size, and vary in shape, the most striking form being a minute ring with a delicate sharp outline and one or more thickenings at the poles. Vibrios, rods, and coccal forms were seen, these forms predominating in some smears. In every case, search revealed some cells with the ring forms. Extracellular forms, identical with the intracellular bodies were noticed, being very numerous in 1 case. Smears were taken on admission, then every 2 or 3 days until the patient was discharged. Inclusion bodies were

present in decreasing numbers during the first week and were usually absent in the second week.

This disease is prevalent throughout Australia, according to the author, who concludes from the random selection of this small group of cases that it also has a wide distribution in Borneo and possibly through the Netherlands East Indies. Information about the transmission of infection is incomplete as no adequate survey of female contacts has yet been published. On the basis of the morphological features seen in these cases, it is tentatively suggested that the inclusion bodies represent an intracellular phase of the pleuropneumonia-like organism which has been shown to be present in a proportion of cases of nongonococcal urethritis.

EUGENE J. AUDI, M.D.

Melicow, M. M., and Ganem, E. J.: Cancerous and Precancerous Lesions of the Penis. *J. Urol.*, Balt., 1946, 55: 486.

The authors make the following observations on penile neoplasms, as dictated by their clinical and pathological characteristics:

1. Though the penis is one of the most often handled parts of the body, neoplastic disease is often well advanced when it is brought to the attention of the physician.

2. Penile cancer is virtually limited to the uncircumcised.

3. The same radical measures which are used elsewhere in the body must be used in the treatment of new growths of the penis and the inguinal lymph nodes must be studied microscopically to rule out the absence of malignancy.

The incidence of penile malignancy is low. At the Squier Urological Clinic, in New York, the incidence is 1 case in every 1,000 admissions; at the Mayo Clinic, Rochester, Minnesota, 0.3 per cent of all cancers in the male are of this type; and at Johns Hopkins Hospital, in Baltimore, 3.5 per cent of all malignancies were penile cancer. The disease is most common in the Far East and in the Orient, and it is seen more frequently in the Hindu than in the Mohammedan. The latter practices circumcision, although not in infancy as in the Jewish ritual, but between the third and tenth year. The only instance of penile cancer in a circumcised Jew is that reported by Dean, and this occurred on the glans which was treated for a sore by an actual cautery.

With these facts in mind, and the apparent role of inspissated smegma as an etiological agent in penile cancer, the authors insist on infant circumcision except in instances of hypospadias, in which the preputial fold is of importance in surgical plastic procedures.

Penile cancer occurs most commonly between the ages of 40 and 70 years; the youngest patient in the series reported was 30 and the oldest 82 years of age. It is emphasized that penile lesions with a positive serology must be studied microscopically to prevent the inoperable extension of a nondiagnosed neoplasm during antitubercular therapy and, too, that ill

healing adult circumcision wounds must be regarded with suspicion.

The duration of symptoms prior to operation varied from 2 months to 5 years.

The usual site of origin is on the glans at the corona or sulcus, and the lesion is most often a squamous cell epithelioma.

The lesions are described in detail, both as to appearance and location, and a sketch is included which clarifies the subject. The lesions most commonly encountered are:

1. *Leukoplakia*. A patch of keratinization on the glans, and there is characteristically no induration or ulceration.

2. *Erythroplasia of Queyrat*. A red, velvety, and slightly thickened patch on the glans with or without a central ulcer.

3. *Page's disease of the penis*. A small erythematous patch of long duration with final ulceration. This lesion may appear on the shaft of the penis since it originates only in the apocrine glands which are not present on the glans.

4. *Bowen's disease*. A lesion of the glans characterized by single or multiple conglomerate, dull, red, scaly papules or nodules with rolled borders. The lesion can resemble clinically that of Queyrat or Page's.

Epithelioma of the penis usually develops either on the glans, or at the coronal sulcus, and may have been preceded by an area of leukoplakia, erythroplasia, or Bowen's disease, which may have been hidden by a phimosis. The majority appear either as papillary or indurated ulcerative areas. The symptoms are those of a painless papillary or indurated area on the glans, prepuce, or at the corona. This lesion is refractory to local treatment and a secondary infection, accompanied by a foul smelling discharge, soon develops. Inguinal adenopathy is due either to inflammatory or neoplastic change secondary to the primary focus.

In the authors' series, 42 per cent of the 19 cases reported revealed neoplastic extension to the inguinal nodes, and it is emphasized that absence of palpable nodes does not rule out cancerous involvement. Too, extension may follow the route of the "vertebral vein system" into which the malignant cells gain access by infiltration of the dorsal vein of the penis. This route explains the occasional cranial, thoracic, or femoral metastasis with no local recurrence following surgery.

It is advised that the diagnosis be made by biopsy of all papillary or ulcerative lesions, and followed immediately by surgery.

The treatment is dependent upon several factors and, in the series reported, the following treatment and disposition were observed.

1. Six patients had a one-stage penile amputation with groin dissection, and varying combinations of x-ray, x-ray, or radium. Of this group, 5 are well, and are without evident recurrence 6 months to 9 years postoperatively; 1 patient died within 3 months.

2. Partial amputation without groin dissection but with postoperative irradiation was performed in 8 cases. In this group, 3 patients died of unrelated causes and presented no evidence of recurrence. Of the 5 remaining, 1 patient developed a recurrence 2 years later, 1 has not been followed, and 3 patients are well 10 months to 11 years later.

3. Two patients were treated by circumcision, but these could not be followed.

4. Three patients were definitely inoperable and all 3 died within a year.

5. One patient was treated by means of the high frequency current, but could not be followed.

Taking the series as a whole, 3 individuals were lost in the follow-up and another 3 died of other causes, so that these authors report 13 carefully followed and evaluated cases. Of these, 3 were inoperable and died, recurrence was seen in 2 instances, and 8 patients are well 6 months to 11 years post-operatively. The number of 5-year cures in this group was 4.

The authors report, in addition, 4 instances of secondary penile cancer. One patient, 71 years of age, had a papillary adenocarcinoma of the kidney with metastasis to the penis, involving the corpora cavernosa; 2 patients had primary lesions in the bladder, and the fourth patient had a penile lesion secondary to an adenocarcinoma of the rectum.

In a review of the literature, the authors found a total of 22 cases of secondary neoplasm of the penis.

The present paper is an excellent review of the subject of penile malignancy; it gives a concise picture of the disease and its treatment, and is profusely illustrated. ROBERT LICH, JR., M.D.

## GENITAL ORGANS

**Mathé, C. P.: Lymphosarcoma of the Testicle. *J. Urol.*, Balt., 1946, 55: 530.**

Lymphosarcoma of the testicle is a rare tumor. It occurred 4 times in 400 testicular malignancies at the Mayo Clinic, Rochester, Minnesota, and once in 34 cases of testicular tumor at the Southern Pacific General Hospital in San Francisco. This is a highly malignant and rapidly fatal tumor of youth, although the aged are not immune, and it may occur primarily or secondarily, unilaterally or bilaterally.

The case reported is that of a 63-year-old individual who did not present a particularly significant past history and whose immediate findings were limited to an enlarged indurated left testicle. The removed testicle weighed 186 gm., and on section the greater portion of the testicle was replaced by tumor, though still limited by the tunica propria. The tumor was of uniform lymphoid consistency, grayish in color, with hemorrhagic areas. Histologic sections showed infiltrating tumor cells of lymphocytic type extending between and into the seminiferous tubules. There were no teratomatous elements found.

The operative wound healed satisfactorily, and 3 months later the patient returned with a recurrence

of the tumor at the site of the severed cord and multiple subcutaneous nodules over the entire body. A biopsy of the subcutaneous nodules showed tumor cells similar to those found in the excised testicle, though of greater activity.

The author discusses the possible etiology of this testicular tumor and its mode of dissemination, which is lymphogenous in a caudocranial direction by way of the lymph glands of the spermatic cord and those of the retroperitoneal, mediastinal, and left supraclavicular regions, respectively. However, that the tumor is not necessarily confined to the lymphatic system is mentioned, and blood stream metastasis is discussed.

The symptoms and diagnosis are reviewed, and the possibility of retroperitoneal lymphatic involvement with ureteral pressure in this type of tumor, is emphasized. The diagnosis is made by the presence of a testicular mass.

Though the literature reveals that only 5.5 per cent of individuals with a testicular tumor live for more than 4 years, in patients with lymphosarcoma there is even a less favorable prognosis.

The present accepted methods of treatment are (1) orchiectomy with surgical excision or irradiation of the regional lymph areas, and (2) irradiation alone. The early surgical excision of the involved organ is considered imperative. It is noted that in less than 15 per cent of the recorded cases did orchiectomy precede extension. It is further noted that orchiectomy in the presence of established metastasis is equivocal as it may merely hasten the process. In addition, the magnitude of the surgical procedure necessary to remove the lymph areas contraindicates its use; however, it is advisable to clamp and ligate the vascular pedicle first at the external ring to prevent dissemination of malignant cells. The wound is bathed with alcohol to destroy any escaped tumor cells.

Frequent postoperative examinations for metastasis are important, and recurrences should be treated with irradiation, as was done in the case reported by the author. In this instance there was an immediate regression of the secondary tumor, although an increase of the secondary nodules followed, in spite of continued irradiation, and at the time of the author's writing the outlook for his patient was grave. ROBERT LICH, JR., M.D.

**Pendergrass, E. P., Chamberlin, G. W., Selman, J., and Horn, R. C., Jr.: The Management of Malignant Tumors of the Testis. *Am. J. Roentg.*, 1946, 55: 555.**

The authors studied 43 patients, all of whom were definitely known to have had malignant tumor of the testis. They classify the tumors as either homologous, composed of uniform cells without organoid arrangement, and heterologous, made up of a mixture of tissues showing various types and degrees of differentiation. Among the 20 homologous tumors in the series were 13 characteristic seminomas. The big incidence of these occurred in the fourth decade,

while the corresponding incidence of the heterologous tumors was spread between the third and fourth decades.

The tumors occurred approximately twice as often on the right side as on the left. The most frequent complaint on admission was a painless scrotal mass, and one-third of the patients had testicular pain. Thirty-eight per cent of 37 patients upon whom data are available had objective clinical evidence of metastases. In all, 58 per cent of the patients showed evidence of metastases at some time. Lumbar pain was an ominous symptom. The tumor spread first to the lymph nodes about the celiac axis by way of the lymphatics accompanying the spermatic vessels; these retroperitoneal metastases frequently gave rise to abdominal cramps and gastrointestinal disturbances.

Only one of the tumors developed in an undescended testis. Breast changes were observed in 9 patients. Hormone assays were done in 6 patients with breast symptoms, and 5 showed positive Freedman tests. Chest roentgenograms demonstrated pulmonary or mediastinal metastases in 13 patients. Excretory urograms revealed retroperitoneal metastases in 60 per cent, chiefly by obliteration of the psoas shadow by a soft tissue mass and displacement of the renal shadow on that side. The return of renal function, apparently due to reduction in size of the metastatic masses around the renal pelvis, was observed in post-irradiation roentgen studies. In several patients there was displacement of the stomach, duodenum, or colon. Urinary gonadotropic hormone bioassay should be carried out before therapy is begun. A positive test appearing after treatment is significant if done within 8 months of orchiectomy. Beyond that time follicle-stimulating hormones may be indicative either of castration effect or of recurrence. A negative test has no significance, except insofar as the absence of follicle-maturing hormone improves the prognosis. In this series no correlation could be established between the results of bioassay and the patient's clinical course. All patients with malignant testicular tumor should have the benefit of irradiation and orchiectomy. The radical regional lymphatic dissection operation of Hinman was not done in this series. During irradiation, weekly leucocyte counts and hemoglobin determinations should be done, and the former should be kept above 1,000. Progressive loss of weight is often associated with a poor prognosis. All patients known to have died of the disease succumbed within 3 years, and more than 50 per cent died within 1 year. The authors believe, therefore, that a "five year survival" is a good indication of prognosis.

In patients free from demonstrable metastases on admission, and receiving conventional therapy (at least 1,000 roentgens delivered to the testis preoperatively), no statistically significant difference can be demonstrated in the five year survival with homologous and heterologous tumors. There is no significant difference in the five year end-result in the groups receiving preoperative or postoperative irradiation. One of the authors believes that pre-

operative irradiation should be seriously considered. It is advisable to continue administering preoperative irradiation on the basis of clinical diagnosis alone until sufficient experience is obtained to evaluate the efficacy of this procedure. However, irradiation of the primary tumor does alter its cellular structure and thereby renders microscopic diagnosis more difficult. In the absence of clinical metastases, the authors suggest the following plan of preoperative treatment.

The factors are 200 kilovolts, 15 milliamperes, 0.5 mm. copper, plus 1 mm. aluminum, and 85 cm target-skin distance. The half value layer is 0.9 mm copper. The fields are planned so that the lymphatic drainage channels of the torso on either side of the midline of the body from the supraclavicular regions to the symphysis pubis, and the inguinal regions and pelvis are irradiated. The portals should extend at least 10 cm. to either side of the midline. The irradiation is started in the peripheral fields, and on successive days the treatment is directed over the adjacent fields. For instance, the first day, irradiation is given over field 1, the second day over field 2, and third day over field 3. When treatment of all of the fields has been completed, the fields are again treated in the same order. The daily increments and the number of fields treated in one day should depend on the ability of the patient to tolerate the radiation. Each field should receive a total dose of 1,600 roentgens in air.

If treatment is to be applied to the primary tumor, it should not be started until all of the other fields have received at least 1,000 roentgens. The involved testicle should be protected as much as possible from primary and secondary radiation by means of a lead cup. The amount of radiation applied to the involved testicle will depend on whether one wishes to destroy the tumor, which will require considerable irradiation, or merely modify its cellular appearance, which can be accomplished readily by 1,000 roentgens.

The operation can be carried out at any time following completion of the roentgen therapy, either immediately or after a delay of a few days to 3 weeks. The authors believe that a simple orchiectomy is to be preferred to a more radical procedure.

If the patient has clinical evidence of metastases, irradiation in that area should be carried to the limit of skin tolerance. Wherever 400 or 1,000 kilovolt therapy is available, it may be beneficial to use such therapy, if the metastatic lesions do not respond to 200 kilovolt therapy.

If postoperative therapy is the method of choice, the following program is presented as a satisfying procedure:

On the strength of clinical evidence of a malignant tumor, the testis should be removed with the least possible trauma, preferably by preliminary ligation and section of the spermatic cord. A roentgen examination of the chest, an intravenous urogram and bone survey, if indicated, should be made preoperatively. As soon as possible after surgery (2 or 3 days

afterwards if the patient can be brought to the department) a course of deep roentgen therapy should be started over the lymphatic drainage areas. The primary drainage areas, situated about the celiac axis, should be completely treated first, followed by successive fields upwards to include finally the left supraclavicular area, and downwards to include the inguinal regions and pelvis. The recommended treatment factors are: 200 kilovolts, 15 milliamperes, 0.5 mm. copper, 1 mm. aluminum, 80 cm. target-skin distance. The half-value layer with these factors is 0.9 mm. copper. The treatment fields should extend at least 10 centimeters to each side of the midline. Each field, anteriorly and posteriorly, should receive at least 1,600 roentgens, measured in air, in divided daily doses. The increase in dosage over the previous conventional treatment is based on the observed difference in radiosensitivity of the various pathologic types, especially the poor response of metastases from the heterologous tumors. In patients with known metastases, the total dosage should be carried to the limit of skin tolerance.

In summary, the overall five year survival rate in the series of 43 patients was 42 per cent, and in patients free from demonstrable metastases, 71 per cent. In patients with metastases the corresponding result is 30 per cent. Four patients (of a total of 24) who had clinically evident metastases at some time during their illness are alive and well 5 to 16 years after their last treatment; in one case there was a supraclavicular mass. There was no difference in end results between preoperative and postoperative irradiation. Preoperative or immediately postoperative irradiation is recommended in all patients with a malignant tumor of the testis regardless of the presence or absence of clinical evidence of metastases.

DAVID ROSENBLUM, M.D.

## MISCELLANEOUS

Jacobi, H. G.: Streptomycin in the Treatment of a Case of Persistent Urinary Infection. *N. York State J. M.*, 1946, 46: 883.

The author reports a case of prolonged urinary infection extending over a period of almost 6 years following a transurethral prostatic resection. During this period 4 operations were performed for the removal of calculi from the kidney and ureter. The infecting organism was at first the bacillus proteus which was subsequently displaced by the bacillus pyocyaneus.

Sulfonamides and penicillin were ineffective in controlling the infection.

Twenty-four hours after the institution of streptomycin therapy the urine became clear and cultures were negative. Repeated cultures for 5 months thereafter still continued to show a sterile, clean urine.

The streptomycin was dissolved in pyrogen-free distilled water and given intramuscularly at 3 hour intervals during the first 3 days and at 4 hour intervals thereafter for a total period of 10 days. The first two doses contained 500,000 units each (in 3 c.c. of water) and the remaining doses 250,000 units each (in 2 c.c. of water).

Blood serum and urine levels of streptomycin were studied during the course of the therapy. It was found that streptomycin is excreted more slowly by the kidneys than penicillin. The blood levels are, therefore, much more stable and can be maintained more readily at an effective level by injections at intervals of 4 hours or even longer. The effectiveness of streptomycin increases with an increase in the pH of the urine.

FREDERICK R. LIENERTHAL, M.D.

# SURGERY OF THE BONES, JOINTS, MUSCLES, TENDONS

## CONDITIONS OF THE BONES, JOINTS, MUSCLES, TENDONS, ETC.

Ferrandu, S.: A Contribution to the Study of the Pathogenesis of Idiopathic Osteopsathyrosis (Contributo allo studio della patogenesi dell'osteopsatrosi idiopatica). *Chir. org. movim.*, 1943, 29: 271.

According to the time of origin of idiopathic osteopsathyrosis, various terms have been applied to the same pathological process; viz., *osteogenesis imperfecta*, congenital osteopsathyrosis, and essential fragility of the bones.

Osteopsathyrosis may be essential, also called idiopathic, or secondary to a number of other conditions, such as simple or inflammatory osteoporosis, rickets, osteomalacia, Paget's disease, fibrocystic osteitis, locomotor ataxia, syringomyelia, poliomyelitis, neoplastic disease of the bones, scurvy, syphilis, or tuberculosis of the bones.

Idiopathic osteopsathyrosis is also called Lobstein's disease.

Vröck's disease, or *osteogenesis imperfecta*, has in common with the condition under discussion the extreme fragility of the bones, but it originates during fetal life and does not carry the characteristic hereditary features; furthermore it causes dwarfism with micromyelia and is responsible for a poor general condition.

Periosteal dysplasia or Porak-Durante's disease causes signs nearly identical with those of *osteogenesis imperfecta*.

The diagnosis of osteopsathyrosis is based on the presence of three signs: (1) blue sclerae, (2) extreme fragility of the bones, and (3) impaired.

Nontraumatic deformities of the skull are very frequent. Kyphoscoliosis is also encountered in numerous instances. While the cortex is abnormally thin, there are no changes in the normal architecture of the osseous trabeculae. Usually one finds an abnormal fragility of the nails and hair, lacunae in the dental cement, abnormally small and translucent teeth, and short bodies with relatively elongated hands and feet.

Of innumerable etiologic factors only thyroid dysfunction seems to constitute a positive finding, the basal metabolism rate usually being increased by 30 per cent. Cortical suprarenalism may also be considered, but the role of the spleen in the pathogenesis of osteopsathyrosis is rather dubious.

JOSEPH K. NARAT, M.D.

Cohn, I.: Dyschondroplasia. *Ann. Surg.*, 1946, 123: 673.

A brief review of the literature leads to the theory propounded in 1928 by Murk Jansen, which the author believes warrants general acceptance.

Six different processes, and probably more, have to co-operate harmoniously in order that the bones

shall attain their proper size, shape, structure, and composition, when completing their growth. These processes are resorption, tubulation, cancellation, cell division, cell enlargement, as well as differentiation.

"Sometimes one or more of these processes will be delayed with regard to the other processes during a shorter or longer period, and the dissociation of each of these processes evokes its own characteristic symptom.

"The clinical picture is characterized by its extreme polymorphism. In some cases only a single bone is found to be affected, and in others the condition presents itself on both sides."

A retardation of tubulation results in a funnel shaped metaphysis, and exostoses are concluded to be the result of partial retardation of tubulation.

Personal observations of cases over a period of 25 years include 6 individuals in two generations of one family, whose photographs and roentgenograms are presented in the original article to bear out the conclusions. *Dyschondroplasia* is a hereditary retardation phenomenon transmitted without regard to sex. It affects shafts of long bones near the ends of the diaphysis, and changes in the epiphyses are entirely secondary. Involvement may be limited to a single bone or may be diffuse in all bones laid down in cartilage. Roentgenographic evidence of dyschondroplasia may be absent in early infancy and appear later, but progress occurs only until full bone growth is accomplished.

True cases of dyschondroplasia manifest evidence of dissociation phenomena which may be both partial and complete, as evidenced respectively by wide metaphyses and spurlike exostoses.

This condition is not a disease but attests to a lack of harmony among the various processes of normal bone growth, and surgical interference is warranted only when there is mechanical interference with joint function, and after epiphyseal growth has ceased.

FRANCES E. BRENNER, M.D.

Sellaroli, M.: Osteoarticular Tuberculosis and Trauma (Tuberculosis osteoarticolare e trauma). *Chir. org. movim.*, 1943, 29: 259.

Osteoarticular tuberculosis after trauma affects the knee, foot, elbow, and shoulder, in given order as to frequency.

Of 1,000 patients with tuberculous osteoarthritis treated by the author, 318 were men and 682 women. In 14.7 of the male patients trauma was responsible for the condition, while the corresponding percentage for the female patients was 12.3. Among the entire 1,000 cases, trauma was suspected as the cause of the condition in 131, or 13.1 per cent. Apparently a traumatized region may be considered a site of minor resistance where tubercle bacilli find a favorable medium for growth. JOSEPH K. NARAT, M.D.

Corsi, G.: Evolution of Tuberculous Osteitis of the Femoral Neck (Evoluzione ed esiti dell'osteite tubercolare del collo del femore). *Chir. org. movim.*, 1943, 29: 153.

Tuberculosis of the neck of the femur is gradually becoming less frequent. The condition is caused by an infected embolus which becomes lodged in one of the terminal arteries. Therefore the condition is found most frequently in children because the collateral arteries develop during adolescence.

Two types of tuberculosis of the neck of the femur may be distinguished, caseous and fungous.

Topographically, 4 groups of the lesion may be differentiated: (1) lesions of the lower cervicodiphyseal arc, (2) lesions of the juxtaepiphyseal region, (3) lesions of the bulbometaphyseal region, and (4) lesions of the subtrochanteric metaphyseal region.

The technique of surgical procedure is difficult because the lesion is located deep within the articular capsule. Moreover, an operation carries with it the danger of spread of the infection with a resulting panarthrits or general dissemination of the tuberculous process which may lead to miliary tuberculosis.

The evolution of the process depends on its invasive tendency and the resistance of the body.

Among 20 cases treated by the author, a cure with good mobility was obtained in 17, and an ankylosis was produced by tuberculous coxitis in 12.

The author advocates conservative treatment with traction and the application of a body cast.

JOSEPH K. NARAT, M.D.

#### SURGERY OF THE BONES, JOINTS, MUSCLES, TENDONS, ETC.

Adson, A. W., Young, H. H., and Ghormley, R. K.: Spasmodic Torticollis. Severe Organic Type Treated by Combined Operation, Rhizotomy, and Fusion. *J. Bone Surg.*, 1946, 28: 299.

The term "spasmodic torticollis" is applied to a group of manifestations consisting of muscular spasms of one or more muscles of the neck. These manifestations may result from emotional instability; from an organic lesion affecting the basal nuclei, peripheral nerves, or muscles; or from a combination of these factors. Not infrequently the discomfort and disability become so severe that surgical intervention is required.

Spasmodic torticollis may involve one or more muscles of the neck and the spasms may be tonic or clonic, or a combination of both. At the onset, the muscles on one side may be affected but the condition may progress to involve the muscles on both sides. The muscles usually affected are those supplied by the spinal accessory nerves and the motor branches of the upper three cervical nerves. The sternocleidomastoid, the trapezius, and splenius muscles are the ones which usually produce the deformities of which patients complain.

The most difficult problem is to determine whether or not the manifestations are of psychogenic or or-

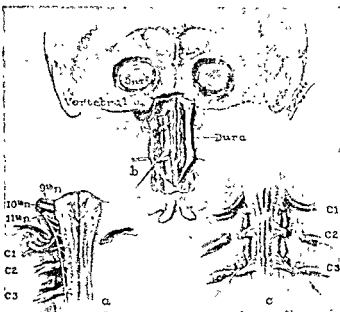


Fig. 1. a, The anatomic relationship of the upper three cervical nerves to the vertebral artery and spinal accessory nerve. b and c, The bilateral rhizotomy of the first and second cervical nerves and the motor root of the third cervical nerve.

ganic origin. It is extremely important to make this distinction because surgical procedures are not justified in the psychogenic type of case. It is necessary to determine the presence of any previous cerebral or meningeal diseases or injuries to the brain, nerves, or muscles. If any such diseases have occurred, they would point toward an organic basis for the development of the patient's symptoms. Since types of spasmodic torticollis may overlap, a conservative course of treatment should be employed first in all cases. By conservative treatment the authors mean the use of a medical regimen before any surgical procedure is advocated or performed. Their experience with conservative treatment of spasmodic torticollis has not been encouraging particularly in cases of the organic type.

When conservative measures fail and the symptoms are severe enough to produce pain and interfere with normal activity, operation must be considered, especially if an organic basis for the symptoms has been found. The authors devised an operative procedure which included bilateral intracranial section of the spinal accessory nerves and bilateral rhizotomy of the upper three cervical nerves with the introduction of a bone graft which had been taken from the ilium and placed in the occipitocervical space. The graft is shaped so that it can be transfixed to the posterior inferior surface of the occipital bone and placed laterally over the ends of the first and second cervical laminae and lateral to the spines of the cervical vertebrae over the third, fourth, and fifth cervical laminae.

The authors have found that bone from the iliac crest is most suitable for the bone graft. They prefer bone from the anterior portion of the iliac crest as a



longer piece of bone can be obtained therefrom than from the posterior portion. The graft is then split longitudinally. Before placement of the graft, holes are drilled in both upper ends in order to pass the wire through the graft as well as through the holes previously made in the skull lateral to the midline. Half of the graft is placed on each side of the vertebra to act as a roof over the spinal canal. The wires are passed through the two pieces of the graft and the holes in the occiput, and are twisted until they hold the graft snugly against the occiput and atlas. The grafts may be trimmed along their borders to ensure accurate fitting against the other cervical vertebrae.

Where a sufficient amount of lamina is left, the edge of the graft can be placed firmly against it, and when the upper end of the graft is fixed, the danger of slipping is minimized. The lower end of the graft is held in place by suture of the muscles firmly over it.

After closure of the wound a plaster cast is applied. This must cover the head, neck, shoulders, and most of the thorax. It should be applied carefully and padded well, but not too heavily.

Two weeks after operation a window is cut in the cast and the sutures are removed. Care must be taken to see that the cast is not weakened at this stage. If it is weakened, it should be reinforced. The cast should be worn from 10 to 12 weeks. After its removal a metal and leather collar is made, and worn an additional 3 months. If at the end of 3 months roentgenograms show solid union of the grafts in the occipitocervical region, the support may be discontinued. If sufficient union has not taken place, the support should be continued until union is complete.

In view of the late results in 2 of the cases the authors believe that the combined operation, bilateral intracranial section of the spinal accessory nerves and bilateral rhizotomy of the upper three cervical nerves, particularly of the anterior roots, with the introduction of a bone graft at the same operation, is indicated for patients who have marked muscular spasm on both sides, for those who are compelled to do manual labor, and for those who have large heads. The major operation on the nerves can be employed without a bone graft for patients whose occupations do not require manual labor. If difficulty in the forward tilting of the head with impairment in breathing, swallowing, or speaking should occur, a subsequent fusion operation may be performed. This combined operation of section of the nerves and fusion of the bone is a major procedure and should be employed only when the patient is incapacitated as the result of spasmodic torticollis.

Venable, C. S., and Stuck, W. G.: Muscle Flap Transplant for the Relief of Painful Monarticular Arthritis (Aseptic Necrosis) of the Hip. *Ann Surg.*, 1946, 123: 641.

Degenerative monarticular arthritis of the hip joint is caused in adults predominantly by injuries or pathological changes of the head of the femur. Contusions, fractures, traumatic dislocations in-

adequately treated Perthes' disease, and slipped femoral epiphyses are some of the causes of degenerative arthritis of the hip joint. The pathological changes are caused by interruption of the blood supply to the head of the femur, which results in ischemic necrosis of the bone and cartilage. Most cases of monarticular degenerative arthritis of the hip develop in the fourth and fifth decades of life. The symptoms are: increasing stiffness, early loss of rotation and abduction of the femur, a catching sensation, pain, and eventually flexion and adduction deformity.

The treatment of these conditions includes the following: conservative measures (physical therapy, traction, plaster cast, crutches) which only provide temporary relief; manipulation of the hip under anesthesia to correct the deformity; and surgery. Several operative procedures are recommended. Osteotomy of the femur changes the axis of weight bearing. Sir Robert Jones recommended trimming of the marginal osteophytes and called this procedure "cheilotomy." Magnusson calls the same operation "joint débridement." Whitman and Colonna excise the head and reconstruct the hip joint. A painless but unstable hip and considerable shortening of the leg is usually the result. L'Epicopo forms a bone block from the ilium to the neck of the femur. Arthroplasty, using viscoloid, steel cups, pyrex glass, bakelite, vitallium, or fascia, increases the motion in the hip joint, but does not relieve the pain sufficiently to satisfy the patient. Fusion of the hip by bone graft or by means of the Smith-Petersen nail results in a permanently stiff hip.

David Brainard, who drilled the head and neck of the femur 90 years ago, and thus facilitated the passage of the capillaries into the neck of the femur, reported the immediate relief of pain. Following this observation, the author transplanted a portion of the vastus lateralis muscle into a longitudinal slot cut into the anterior surface of the neck of the femur. After the operation, the patient had immediate and lasting relief of pain. Of the 27 patients operated upon, 26 allegedly have gained marked pain relief which lasted as long as 2 years. A number of x-rays are presented illustrating preoperative findings and cup operations. No detailed history, preoperative and postoperative findings, or follow-up observations are given. George I. Reiss, M.D.

Ponseti, I.: Pathomechanics of the Hip after the Shelf Operation. *J. Bone Surg.*, 1946, 28: 259

The article presented is based upon 63 patients (11 males and 52 females) with dislocation of the hip joint. There were 61 congenital dislocations, of which were of prenatal origin, and 54 of postnatal origin. Nine were congenital subluxations. The average follow-up period was 7 years, and the ages of the patients varied from 2 to 36 years. In 42 hips, the shelf was built at the primary acetabulum; in 23, it was constructed at the secondary acetabulum. In 12 hips, the femoral head was completely dislo-

cated and there was no secondary acetabulum. In 5 hips, in which a shelf operation was done, the greater trochanter was detached together with its muscle attachments and reattached from 1 to 3 cm. down over the lateral aspect of the femur.

The telescoping sign disappeared after the operation in 51 cases and persisted in 1 case of posterior dislocation. The Trendelenburg sign was observed in 73 hips prior to the operation. In 61 hips, the sign persisted after the operation. Fifty-one hips were free of pain before the shelf operation and remained free of pain after the operation. In 7 cases, there was pain in the hip on admission, but it disappeared after operation. Fourteen hips were pain-free before, and became painful after, operation.

In all of the patients, the distance between the center of the femoral head and the line drawn through the longitudinal axis of the sacrum was measured on the anteroposterior roentgenogram. On the average, this so-called Y-co-ordinate was found to measure 5.5 cm. It was found that if the Y-co-ordinate of the hip with a surgically created shelf measured less than 1.2 cm., as compared with a normal one, the functional result was satisfactory. The greater the difference between the Y-co-ordinates, the more pronounced was the limp. The best results were found in hips in which the femoral head was close to the line of gravity; they did not depend upon the length or thickness of the shelf. The ultimate results were the same regardless whether the greater trochanter was or was not surgically displaced downward over the lateral aspect of the shaft.

In conclusion, it is stated that in children under the age of 4, with congenital dislocation of the hip, the shelf operation is contraindicated. The development of the hip muscles and the prolonged position of the limb in abduction and inward rotation were sufficient to maintain the femoral head in the acetabular cavity. For children over 4 years in whom the closed reduction has failed, an open reduction with the construction of a shelf may be indicated. It is emphasized that the surgeon should not depend too much on the shelf, but rather concentrate on the proper position and maintenance of the femoral head within the acetabular cavity. In adults, the shelf operation contributes additional support to the femoral head and relieves the strain on the capsule and ligaments of the hip joint, thus relieving the patient's pain. The limp, however, may persist.

In cases in which the femoral head cannot be reduced into the primary acetabulum, a well performed Shanz osteotomy gives good functional results. If a Shanz osteotomy is performed on a child, the angle of the osteotomy will gradually disappear and the femur may become completely straight as the patient grows. Therefore, it is better to observe these patients until puberty and if pain occurs, to perform the Shanz osteotomy at that time. In young patients with irreducible posterior dislocations in whom the femoral head tends to become displaced upward and backward under the iliac wing, a Shanz osteotomy is indicated and may be

repeated at a later date. The anterior transposition of the femoral head, in cases of posterior dislocation of the hip joint, is considered very traumatic and should be abolished altogether. Reaming and deepening of the acetabular cavity usually results in stiffness of the hip joint. GEORGE I. REISS, M.D.

Aldredge, R. H.: Indications for the Syme Amputation. *Surg. Clin. N. America*, 1946, 26: 422.

The Syme operation was first described in 1843, and many conflicting reports on its merits have been presented at intervals ever since. To evaluate these opinions the author divides the cases into (1) war cases, or those which are or recently have been infected, and (2) civilian, or clean cases.

In World War I many of the unhappy results occurred in cases in which surgery was done in the presence of, or soon after, infection—therefore in poorly selected cases. Experience in the recent war has proved that this cause of failure can be eliminated, and then good results can be obtained.

On the other hand, clean or civilian cases have shown stumps functioning well for as long as 50 years of useful living with little handicap. These cases were operated upon before modern asepsis was developed, which makes the results more remarkable. Canadian surgeons are strong advocates of this procedure after following their World War I cases up to the present time.

The advantages of the procedure are several, but the main one is the preservation of a maximum amount of the extremity and full length leverage plus full end-bearing, with or without a prosthesis. It is possible for patients with even double Syme amputations to walk on the bare stumps in the house. With a prosthesis no apparatus extends above the knee, a particular advantage when a higher amputation exists on the other side. Syme amputees are not handicapped or incapacitated, merely inconvenienced. The bootlike prosthesis is fitted and maintained with relatively little trouble as compared with results following below-the-knee amputations, and function is excellent. When a partial foot amputation which will permit reasonably good function can be done, a Syme amputation should not be done in preference, but sound judgment must decide each case on its merits.

The only true disadvantage of the operation is esthetic, and therefore it is rarely done on a woman. For an adequate result, i.e., full painless end-bearing, the surgeon must meticulously carry out the surgery and personally conduct the aftercare until the patient is satisfactorily fitted with a prosthesis.

Indications are greatest among war injured in whom a functionally inadequate remnant of the foot is left. Open stumps must be clinically and bacteriologically clean, and edema must be at the irreducible minimum preoperatively. Split skin grafts may hasten the closure of old wounds, which is preferable before the Syme amputation is done. Cleanliness of the stump preoperatively is essential with bedrest and elevation of the stump. Penicillin given

preoperatively and postoperatively guards against activation of latent infection. Lumbar sympathectomy has preceded this operation when major venous ligation existed previously. Fractures of the lower tibia and fibula should be solidly healed as a prerequisite. All possible heel length is desirable, but with only 1 inch of heel a satisfactory Syme amputation can be done. If the heel remnant is fixed in equinus an advantage is obtained in that the skin is less redundant and less shrinkage occurs afterward. The skin of the heel must have good circulation and sensation, and be free from excessive scarring. When skin from the sole of the foot is not available for the stump, it is better to do a below-the-knee amputation and avoid disappointment.

The Syme amputation should never be a primary procedure on war casualties, nor in the presence of nearby unclean wounds. Loss of sensation, and peripheral vascular disease, with or without diabetes, are definite contraindications. Carefully selected cases of forefoot gangrene due to frostbite or trenchfoot have given satisfactory results.

FRANCIS F. BRENNER, M.D.

#### FRACTURES AND DISLOCATIONS

Higsmith, LaR. S., and Phalen, G. S.: Sideswipe Fractures. *Arch Surg*, 1945, 52, 513.

Fracture sustained with the left elbow projecting out of the window of a car which is sideswiped by an

oncoming vehicle is one of the most devastating injuries involving the elbow joint. The resulting injury is of such great magnitude that amputation is mandatory in about 50 per cent of the cases.

This fracture is a civilian casualty, and should be sufficiently publicized to impress the driver with the importance of keeping his arm inside the car while driving.

The authors report 7 cases of sideswipe fracture occurring among Army personnel. In 2 of the cases amputation was performed at the lower third of the humerus. In 2 other cases borderline amputations were done. In 3 of the cases nonunion of the humerus resulted at the supracondylar level.

The treatment consists of (1) débridement by guile technique, (2) primary suture of the disrupted nerves, (3) cervical sympathetic block in all cases of vascular impairment, (4) extirpation of the loose bony fragments, (5) application of a cast from the axilla to the metacarpophalangeal joint, with the elbow flexed at a 90 degree angle, and (6) guile amputation.

While some orthopedic surgeons have advocated immediate resection of the entire elbow joint, the authors lean toward conservative treatment. When extensive comminution of the bone exists, internal fixation—including wires, pins, and plates—is not the treatment of choice.

SAMUEL L. GIVERSALL, M.D.

Fiske, L., and Shapiro, A. L.: Trimalleolar Fractures of the Ankle Joint. A Conservative Method of Treatment. *Am J Surg*, 1945, 71, 625.

This report is based on a series of 33 trimalleolar fractures treated during a period of 8 years by the method described. The results were good from the functional standpoint in the 32 cases in which treatment was completed. Twelve of the patients were followed up for long periods.

The article discusses the history, anatomy, mechanics, and pathology involved in these injuries, and mentions the tendency of recent writers to recommend operative reduction. The method preferred by the authors is a 2 pin procedure using a mechanical distraction apparatus. The importance of accurate anatomic alignment of the fragments from the moment of reduction until union has taken place is stressed; it is difficult to achieve this in fractures in which one-third or more of the posterior articular surface of the tibia has been displaced.

The treatment varies according to the severity of the injury. First degree injuries, in which a small chip fracture of the lower posterior articulating surface of the tibia is detached and a partial displacement of the foot has occurred, are treated by manipulation, under either general or local anesthesia, and with the patient's knee and thigh flexed to relax the gastrocnemius muscles. Reduction is accomplished by downward traction, the foot being pulled anteriorly. The foot is dorsiflexed to 100 degrees and placed in slight inversion. This position is main-



Fig. 1. A, Anteroposterior, and B, lateral roentgenograms of left elbow taken 9 weeks following sideswipe fracture. There is little evidence of healing in the extensively comminuted humeral fracture.

tained by a boot length cast. No weight bearing is permitted for 8 weeks. Second degree injuries, in which a fragment comprising about one-third of the posterior articulating surface of the tibia is displaced and a subluxation of the astragalus is present, are manipulated as the first degree injuries, but when this fails, skeletal traction by means of a Kirschner wire or a Steinman pin is used. Sometimes a tenotomy of the tendo achillis is performed. The pins are placed in the middle third of the os calcis and in the tibia posterior to the tubercle. They are distracted by means of the MacMillan apparatus under observation with the fluoroscope. An assistant makes firm pressure on the shaft of the tibia as the foot is dorsiflexed. The traction is released when the astragalus is opposite the articulating surface of the tibia and the joint relationship is restored. In these cases the cast extends from the upper third of the thigh to the toes, the pins being incorporated in it. The foot is held at 100 degrees dorsiflexion and in inversion or eversion as required by the fractured malleoli. The pins remain in place from 10 days to 3 weeks or longer. Third degree injuries present complete dislocation of the foot. Their treatment is the same as that for second degree injuries, but often the tendo achillis must be tenotomized.

Postoperatively, one must watch for loosening of the cast. The pins should be left in place long enough to control the fragments despite the loosening of the cast.

NEWTON C. MEAD, M.D.

Lindsay, S., and Moon, H. D.: Bone-Marrow Embolism following Fracture. *J. Bone Surg.*, 1946, 28: 377.

When fat embolism of the lungs and brain occurs, it most often follows fractures of the shafts of the long bones. Such embolism occurs less frequently after fractures of the flat bones than after fractures of the ends of the long bones. Although 600 cases of fat embolism have been recorded in the literature, only 1 case of associated bone-marrow embolism to the lungs has been reported.

It seems probable that bone-marrow embolism occurs frequently after fractures. It would be necessary to examine the entire pulmonary tissue by microscopic sections in order to demonstrate the few fragments of marrow which have been liberated into the vascular system at the fracture site. The finding of such emboli in a few sections of pulmonary tissues is purely accidental. Three case reports are given in detail.

EMIL C. ROBTISHEK, M.D.

Soave, F.: The Intramedullary Nail Technique for Treating Fractures of the Long Bones, According to the Method of Kuentscher, and Its Indications (*L'inchiadamento midollare delle ossa lunghe secondo Kuentscher, e sue indicazioni*). *Arch. ital. chir.*, 1944, 66: 271.

The method of treatment of serious types of fracture, which was described by Kuentscher in 1941 under the designation of "Marknagelung," consists of the introduction of a long, relatively slender rod

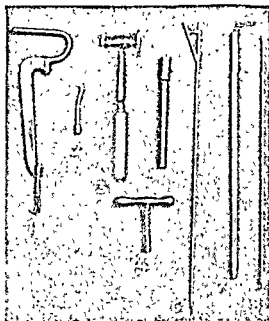


Fig. 1.

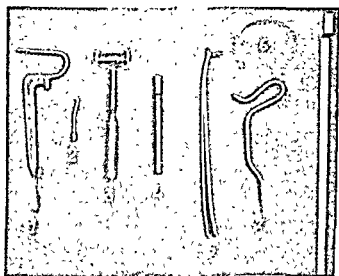


Fig. 2.

Fig. 1. Instrumentarium for a femoral fracture: 1, extrator; 2, extracting hook; 3, mallet; 4, handle of guide; 5, bone punch; 6, guide; 7, intramedullary nail (Marknagel); and 8, extrator guide.

Fig. 2. Instrumentarium for a tibial fracture: 1, extrator; 2, extracting hook; 3, hammer; 4, bone punch; 5, double intramedullary nail; 6, protective circular band; 7, hand perforator; and 8, metric, metallic measuring instrument.

along the medullary canal of both the upper and lower fragments of the broken bone. This rod, or nail, which must be chosen to fit each case, is made of an alloy which is known as "V2A extra." Near one end of the bone an oblique hole is bored through the cortex into the medulla and the rod is driven into place under roentgen control after reduction of the fracture or pseudarthrosis. The intramedullary nail may be withdrawn with a special tool. (Figs. 1, 2).

The author treated 3 cases of old, deformed, non-union fractures (1 of the left leg, 1 of the right forearm, and 1 of the left forearm) with this technique and asserted that these were the first 3 cases so treated in Italy. The results obtained were excellent. The limb did not require other support while it healed, the period of treatment in the hospital was very much shortened; and there was no evidence in any instance of infection or interference with the development of callus. In each case, when the nail was extracted, it was as smooth and as highly polished as when it was introduced.

JONAS W. BRENNAN, M.D.

### ORTHOPEDICS IN GENERAL

Regan, J. M., and Chatterton, C. G.: Deformities following Surgical Epiphyseal Arrest. *J Bone Surg.*, 1945, 28, 265.

This report includes all surgical epiphyseal arrests performed at the Gillette State Hospital from June 1, 1933 to December 31, 1943, inclusive, which afforded a postoperative checkup of at least a year to December 31, 1944. During this period of 10 years and 7 months, a total of 36 patients underwent operation for epiphyseal arrest for inequalities of leg length. The etiologic factors for the discrepancies of leg length in this series seemed to coincide with the findings of most writers. Tabulations were made including the sex, epiphyses arrested, age at time of operation, amount of discrepancy in length of legs at the time of operation and at the time of follow-up, and length at the time of the follow-up. In some instances equalization did not occur, yet the procedure arrested progressive discrepancy. It is interesting to note that deformities following arrest and directly attributable to the procedure occurred only in males in this series; this fact, of course, is of no significance in determining the outcome of the operation.

The technique of Phemister was followed in all cases, with only slight modifications, depending on the individual surgeon performing the operation.

Of the 36 patients, 4 showed noticeable deformity in from 2 months to 2½ years after arrest had been effected. In 3 of these cases corrective surgical procedures were performed after the deformity occurred and in 2 of these re-arrest of the epiphyses was performed at the time the corrective operation was done. In the fourth case the authors contend late corrective osteotomy if the deformity increases.

Blaine, G.: Experimental Observations on the Use of Absorbable and Nonabsorbable Plastics in Bone Surgery. *Brit. J. Surg.*, 1945, 32, 215.

Experimental investigations were made of non-protein and protein plastics. Of the nonprotein plastics the following were studied: methyl methacrylate, cellulose acetate, nylon, urea and phenol. Methyl methacrylate proved most satisfactory.

The protein plastics studied were made from casein, fibrin, casein with plasma, red blood cells, and whole blood. The protein plastic chiefly studied was casein plastic.

A detailed description of the preparation of casein plastic is given. This plastic is placed in a formalin bath (4 per cent), which penetrates about 1 mm. in 14 days, this makes it 30 per cent stronger, and eliminates the element of putrefaction. These plastics can be machined to provide screws, plates, blocks, and nails. The strength of these plastics is approximately that of bone. The strength increases with greater formalization, and decreases if stored under unsatisfactory conditions.

Protein plastics are completely absorbed by the tissues. The speed of absorption depends on: (1) the degree of formalization, (2) the bulk of the implant, and (3) the tissue in which it is placed. Absorption is faster in bone than in skeletal muscle.

Nonprotein plastics are not absorbed in the soft tissues or in bone. Methyl methacrylate is well tolerated by the tissues and often produces little or no fibrous reaction. Methods of rapid molding of acrylic sheets make this plastic more useful in bone surgery in the primary operative procedure.

DANIEL H. LEVENTHAL, M.D.

# SURGERY OF THE BLOOD AND LYMPH SYSTEMS

## BLOOD VESSELS

Blakemore, A. H.: Angiography—An Evaluation of Its Usefulness. *Surg. Clin. N. America*, 1946, 26: 326.

In this article, the author discusses some of the outstanding benefits of angiography. Because of their relatively low toxicity and rapid elimination the iodides are favored as contrast media for the x-ray visualization of the vascular system. Of the group, diodrast is a popular compound in America.

It is indeed a compliment to the many contributors to angiography to state that in a short number of years, since its beginning, it has become possible to obtain excellent pictures of any portion of the human vascular system. Techniques have been evolved which make the safety of angiography in any region entirely commensurate with its diagnostic importance in given instances. This implies that cerebral angiography should not be employed on the slightest provocation, but it does mean that when there is a question of serious doubt in diagnosis the cerebral vessels can be visualized safely to rule out, for example, the presence of an arterial aneurysm. Angiography of the vessels of the head has been employed to localize more accurately the site of a traumatic arteriovenous fistula. In cases of congenital arteriovenous aneurysm of the cerebral vessels important information may regularly be gained from angiography.

The method of aortography is discussed in detail. The right common carotid artery has been used for retrograde visualization of the arch of the aorta by means of a long, flexible needle with a tapered blunt stylet. Visualization in sequence by x-ray of the superior vena cava, the heart chambers, the pulmonary vessels, the aorta, and its branches following the rapid introduction of 70 per cent diodrast in an arm vein represents a truly great achievement in angiography. In cardiovascular disease, this method of contrast roentgenography has given a degree of precision in diagnosis previously unattainable. It may aid in the diagnosis and treatment of the various types of mediastinal disease. The most striking results are obtained, however, in disorders such as aneurysm of the pulmonary artery, aortic disease, and pericardial and congenital abnormalities in which recognition is difficult or impossible with conventional methods of study. Whereas the technique of carrying out serial contrast roentgenography following opacification is exacting, proficiency in the procedure can be readily acquired through training and practice, and successful performance should be within the capability of every medical center.

The author states that arteriography of arteriosclerotic peripheral arteries should not be dismissed without a word of caution. It should be remembered that all the radiopaque substances employed in

angiography are irritating to the vessel wall, some more than others. Although it may be claimed that the irritation is insufficient to cause enough direct damage to the intima to serve as a localizing focus for the initiation of a thrombus, the substances all do cause vasospasm. The latter may, in the presence of arteriosclerotic intimal plaques, be just sufficient to initiate thrombosis in the distal branches of the artery.

Some observers in the early days of angiography suggested the method as an aid in revealing the adequacy of collateral branches around areas of obstruction. Arteriography for this purpose is dangerous and, furthermore, because of the superimposed vasospasm, it is not particularly informative. Perhaps the most informative and certainly the most interesting application of angiography is in cases of arteriovenous fistula, congenital or acquired. Whereas in congenital fistulas, which are almost invariably multiple, the angiogram may not always show up the actual fistulas, it is sufficiently localizing to be an important guide to surgical therapy.

The case of an 11 year old boy with an overgrowth of the leg is presented and discussed in detail. The exact explanation of overgrowth of the extremities in children having arteriovenous fistula is not known. The skin temperature difference between the normal and affected limb may be marked. The simplest proof of this is exhibited during ether anesthesia. At the start of the anesthetic the affected limb will be warmer, but after a third stage anesthesia is reached the temperature in the normal and affected limb becomes equalized. It is probable that the diminished vasomotor tone in the limb affected by arteriovenous fistula is chemical in origin, perhaps due to an increased carbon dioxide content.

Overgrowth of the bones and soft parts are the most distressing features of arteriovenous fistula in children. Bone overgrowth is not of great concern, however, because it simply means that the epiphyses will close earlier in the affected member and in time the bone growth in the normal limb will catch up. For this reason the author states that he is not in favor of operating upon the epiphyses. And for the same and other reasons he is against the use of x-ray treatment. Excision of the fistulas is the ideal therapy.

The role of angiography in arterial anastomosis is discussed in detail. Arteriograms are not necessary to determine the patency of anastomoses in clinical cases that have been carefully followed. Arteriography shows whether a given anastomosis is patent or not, however, and is useful as a photographic record which may be employed in testing the efficacy of a given technique of blood vessel anastomosis. Arteriography was employed in testing the efficacy of a nonsuture method of blood vessel anastomosis with vitallium tubes.

The author states that there are occasions in which venography is extremely useful. Its greatest usefulness is in determining the adequacy of the deep venous system of the leg in old postphlebotic cases. In such cases it may be desirable to strip the great saphenous vein because of varicosities, or to do a flap dissection for ligation of the perforating branches.

HERBERT F. THURSTON, M.D.

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The incidence of vascular injuries in World War II has been 0.66 per cent of all wounds in the American Army. Vascular injury was the cause for 10.5 per cent of the amputations. The therapy of vascular wounds has been limited by the time lag which is unavoidable in military surgery. In most cases the treatment was complicated by injuries to structures other than the blood vessels, e.g., bones, nerves, and muscles. The incidence of amputation was appreciably higher in the cases in which vascular injuries were complicated by fractures. On the basis of the American experience in World War II, as well as the British experience in World War I, it is apparent that the site and type of the vascular wound determined the therapeutic procedure and, therefore, predetermined the end results. Thus a wound of the popliteal artery was much more likely to be followed by ischemic gangrene than a laceration of the brachial artery. The great majority of the wounds in World War II were produced by shell fragments; they were large and were associated with extensive destruction of tissue, hence frequently they resulted in the loss of much of the potential collateral circulation. As a result the vitality of the limbs was gravely impaired before the surgeons ever saw most of the patients. Infection was not a common complication.

Of necessity, the most common type of treatment of wounded arteries was ligation. The incidence of gangrene was higher than that reported by Makins in World War I; the difference was attributed to the exclusion of chronic cases, such as arteriovenous aneurysms, from the American Army series. Despite the evidence previously adduced by various authors to demonstrate the value of concomitant venous ligation, the incidence of amputation when the vein was ligated along with the artery was not appreciably lower than when the artery alone was ligated.

Repair by suture was rarely possible because of the time required and the extensive wounds that were usually encountered, with widespread destruction of tissue and such loss of arterial substance that end-to-end anastomosis was rarely feasible. Only 81 cases were treated by suture and most of these were small lateral lacerations, involving a third or less of the circumference of the vessel. The incidence of amputation in this group was 35.8 per cent, not strikingly better than the figure of 48.9 per cent in the group treated by simple ligation.

Forty patients had nonsuture repair with vein grafting according to the technique of Blakemore

and Lord. The incidence of amputation was highest in this series (57.5%), and the procedure was found to be very time-consuming. An anastomosis was performed with a plastic tube in 14 cases, half of which were subsequently subjected to amputation.

Anticoagulant therapy was rarely employed as a supplemental therapeutic measure because of the time lapse from the injury to the first definitive treatment, because of the frequent presence of other injuries, and because of the difficulties of control by means of evacuation. Sympathetic block with procaine was performed frequently, but in the material available for analysis it was possible in only 278 cases to determine definitely that the procedure had been performed or had been omitted. The incidence of amputation was 39.3 per cent in the patients who had received blocks, and 48.8 per cent in those who had not. In 42 cases sympathectomy was done, with subsequent amputation in 71.4 per cent. The latter was probably necessary because of the fact that the sympathectomy was used generally only as a last resort. Despite their lack of statistical evidence, the authors are convinced that both sympathetic block and ganglionectomy are of considerable value after arterial injury. Fasciotomy to relieve pressure on ischemic muscles in tight fascial compartments was used in only a few American cases. The results were good occasionally except in patients with wounds of the popliteal artery, and in the majority of these the results were poor. Refrigeration was not considered practical under combat conditions.

The complications and sequelae included secondary hemorrhage only rarely, and gas gangrene in 11 per cent of all amputations. No statistics were available on the incidence of causalgia, but it was noted to be higher when there were associated nerve injuries. A great many of the patients suffered from various manifestations of circulatory insufficiency, such as color changes, intermittent claudication, and even partial paralysis. Most of these conditions improved after sympathectomy. The treatment of ischemic contractures has been less satisfactory.

TUTDORE B. MASSELL, M.D.

Ogden, E., and Sherman, R. S.: *Physiologic Considerations in the Care of Patients with Varicose Veins. Arch. Surg.*, 1946, 52: 402.

Considered from a physiologic point of view, the chief features of all varicose conditions are (1) valvular incompetence, (2) raised venous pressure, and (3) edema. Congenital inadequacy in one or more pairs of venous valves at the upper end of the long saphenous system begins with mild incompetence during the preadolescent years, and progresses into generalized venous breakdown which is accelerated or precipitated by pelvic congestion, by any factor raising intra-abdominal pressure, by prolonged standing, or by occupations which involve repeated straining. The upper valves failing, the column of blood sustained by the lower valves becomes longer and therefore heavier, which causes the veins to give

way. This increased tension produces (1) a thickening of the muscular coat of the larger vessels so that they feel straight, thick, and firm, and (b) tortuosity, reverse flow of blood in the smaller vessels. A blood flowing downward and entering the deep veins via perforating vessels and then ascending and flowing back through the saphenofemoral junction or through the perforating vessels up in the thigh. Raised venous pressure and stagnant anoxia occur, which combine to upset the balance of turnover of the tissue and produce edema; this stagnant flow of fluid leads to the formation of fibrous tissue, discoloration of the skin, and ulcers.

In varicose veins without complications, a complete personal and occupational history, as well as an evaluation of the development of signs and symptoms, is of value for determining the prognosis of the varicose condition and the probability of recurrence after treatment. Life expectancy of the patient, evidence of arterial inadequacy, and previous treatment are a few of the important factors to be weighed before physical examination and treatment are carried out.

In the examination the following factors should be noted: (1) the size and tension of the visible veins and the presence of varices; (2) the presence of reverse flow in the long saphenous vein, also the thickness of the wall of this vein; (3) evidence of deficiency in the arterial circulation as manifested by color and temperature changes, and the presence of arterial pulsations; (4) the presence of deformities or orthostatic defects in the feet; (5) the presence of pain, which usually is an indication of thrombophlebitis; (6) the presence of ulcers, dermatitis, edema, telangiectasis, or pigmentation; and (7) the presence of fungus infection. Reverse flow in the perforating veins below the knee is best determined by rapid filling time of the veins when a tourniquet is applied below the knee; the incompetent communicating valves thus revealed are a poor prognostic sign, and the patient at best may expect to have trouble more or less during the rest of his life. If there is no venous incompetence below the knee, incompetence at the place where the short saphenous vein perforates the fascia into the popliteal space may be determined by observation of rapid reverse filling of the saphenous vein when a tourniquet is applied above the knee. Major valvular incompetence somewhere in the saphenous vein may be determined by rapid filling of the saphenous vein when a tourniquet is applied high up on the thigh below the saphenofemoral opening. Finally, incompetency of the valves of the long saphenofemoral opening may be determined by rapid filling of the vein when a tourniquet placed at the top of the thigh is released.

The aim of all treatments of uncomplicated varicose veins is the elimination of back pressure on the capillaries, which indicates a backward flow through an incompletely guarded communication between the superficial and deep venous systems—the elimination of all perforating vessels with incompetent

valves is the logical treatment. This is straightforward when incompetence occurs at the saphenofemoral opening, the so-called "high saphenous ligation," but it is important that enough of the femoral tributaries are above the point at which the saphenous vein has been tied; if any are present they should be tied, cut, and removed. The stump of the vein should be tied as closely as possible to the femoral vein and 5 cm. of the vein should be excised. A sclerosing solution may be injected distally into the main trunk of the saphenous vein. Full activity of the limb may be tolerated within a few days. Recurrence of the symptoms following operation may be due to (1) too low a ligation, or (2) failure to visualize the femoral vein and ligate all its upper branches; recanalization of the saphenous vein by reverse flow through incompetent valves in the perforating vessels may also occur.

As it is often difficult to isolate and tie off all these vessels, Sherman's stripping procedure, which is designed to interrupt the perforating vessels, may be carried out at the same time as the high ligation. This procedure, done with a vein stripper which is passed down the length of the thigh and part of the leg, is designed to explore the pattern taken by the saphenous vein and to avulse all parts of it which might communicate with the deep system. After a sclerosing solution is injected into the vein, it is then nicked at various points and inspected for bleeding. Many surgeons who believe that this procedure is too radical advocate a simultaneous high and low ligation of the internal saphenous vein.

The injection of sclerosing solution alone, usually followed by recanalization, is useful only in certain conditions: for instance, (1) in treating trifling varices for a cosmetic effect; (2) when surgical treatment is contraindicated; (3) when operation must be deferred; (4) when surgery is refused; (5) during pregnancy; (6) when supplemental treatment to surgery is desired to obliterate persistently distended veins; and (7) when incompetent veins below the knee limit the success of the operative procedure. Incompetent perforating veins below the knee cannot, as a rule, be successfully ligated, mainly because they are multiple and of uncertain location; in these cases a high ligation and local sclerosing injections should be employed.

The outstanding complications of varicose veins are (1) dermatitis, (2) edema, (3) varicose ulcer, and (4) thrombophlebitis. Dermatitis and itching are due chiefly to fungus infection; control of the edema which allows the fungus to thrive is the prime treatment, although various local medicaments, such as 5 or 10 per cent silver nitrate in 50 per cent alcohol or a hot strong solution of magnesium sulfate, give relief. High saphenous ligation usually brings about resolution of the dermatitis, although caution must be observed that the infection does not invade the operative site. Uncomplicated edema is controlled by rest with the feet elevated and tight bandaging. An effective although intricate pressure bandage is



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described; it consists of a layer of sheet wadding placed over the skin (previously covered with tincture of benzoin), close fitting rubber sponges on each side of the leg, gauze bandages, and adhesive tape applied like a puttee. This bandage is left on a week and then another is applied. The degree of tightness depends on the status of the arterial circulation. When edema is thus eliminated a well fitting elastic stocking may be employed. True varicose ulcers heal spontaneously and rapidly in the absence of edema, venous back flow, or vascular insufficiency. Rest and elevation of the feet usually suffice, although healing may be facilitated by the application of silver nitrate solution and the pressure dressing mentioned previously. A painful inflamed ulcer is treated in a similar manner, codeine and salicylates being used during the first day or two that the bandage is in place; when the edema is eliminated the ulcer clears.

Thrombophlebitis may be divided into three categories: (1) low grade superficial thrombophlebitis; (2) progressive superficial thrombophlebitis; and (3) femoral thrombophlebitis. In the first group, soreness and bruising of superficial varicose veins are the chief complaints; the disease is generally self limited and requires no particular therapy. Extensive superficial varices often are the site of a rapidly progressing superficial thrombophlebitis (this is seen especially in pregnancy); the region is tender and inflamed, it may spread to the saphenofemoral opening, but the femoral system is rarely invaded and emboli are seldom produced. It is of prime importance, however, to distinguish this condition from deep femoral thrombophlebitis. Since there is no particular hazard connected with superficial thrombophlebitis, symptomatic measures usually suffice (rest, narcotics, warm or cold applications), although ligation of the saphenous vein at the saphenous opening may be carried out with more rapid resolution of the symptoms. This condition is frequently the forerunner of an ulcer.

Deep femoral thrombophlebitis is a true hazard to life because of the danger of emboli. It is usually heralded by pain, tenderness, swelling of the thigh and leg, and signs of infection (elevation of temperature), and immediate measures should be taken to combat it, such as (1) immediate ligation of the femoral vein below the junction of the profunda femoris and removal of the clot by aspiration; (2) sympathetic block; (3) rest and elevation; and (4) employment of heparin or dicoumarin. The best prophylactic measure against deep thrombophlebitis is that the patient keep his legs active while in bed.

The bearing of this condition on a discussion of varicose veins lies in the overtaxing of the superficial venous system and the production of varicosities when the deep system is obstructed. When this occurs, the development of superficial varicosities should be anticipated and forestalled, or at least delayed. Rest and elevation should be enforced until all edema has disappeared. When the danger of embolism is passed, blood flow should be promoted

by warmth, massage, and active movement. The use of an elastic bandage or stocking is advocated, and the patient is to be warned against (1) walking without support; (2) pregnancy; (3) straining or lifting; and (4) constipation. Signs of growing valvular incompetence should be watched for. No surgery should be attempted on the long saphenous system until the deep femoral system has been demonstrably recanalized and is capable of carrying the whole venous return; a year should elapse prior to surgery to allow for subsidence of a possibly dormant infection. Complete cure is seldom effected, and no false hopes should be held out to the patient.

PETER B. CHASE, M.D.

### BLOOD; TRANSFUSION

Rosenthal, N., Zimmerman, S. P., and Shapiro, S.: The Prothrombin Level of the Peripheral Blood and the Sternal Marrow. *Arch. Int. M.*, 1946, 77: 420.

Although much is known about the properties of prothrombin, little is known of its metabolic cycle. Conclusive evidence is lacking that the liver is the major or sole locus for its synthesis. Prothrombinopenia accompanies artificially induced or clinical hepatocellular damage and thus it has been felt that the liver plays an important role. Which of the components, the parenchymatous or the reticuloendothelial cells, performs the action has not been determined. Little is known, also, of the manner in which vitamin K and dicoumarin exert their influences on the prothrombin levels.

In an attempt to determine whether a relationship could be found in the production of prothrombin between the reticuloendothelial activity and function presumably of the liver, the authors took an indirect approach. A comparison was made of the prothrombin clotting time of plasma obtained simultaneously from the peripheral venous blood and from the sternal bone marrow.

Studies were made on whole and diluted plasma (12.5 per cent). Twenty-eight normal patients were studied and it was established that there was no significant difference between the prothrombin level of the peripheral blood and that of the bone marrow. From this it was concluded that the reticuloendothelial system is not involved in the production of prothrombin.

Next, 8 patients were given large doses of quinone and no difference was found between the marrow and peripheral plasma, each showing a similar decrease in the prothrombin time. Thus, during a period of rapidly increasing production of prothrombin there was no difference between the peripheral and plasma marrow. This added support to the contention that the bone marrow and the reticuloendothelial system are uninvolved in the metabolism of prothrombin.

A third series of studies was made on 7 patients who were given significant doses of dicoumarin 48 hours before the samples of blood were taken. A prolongation of the prothrombin time with a dissocia-

tion of the effect on the peripheral and marrow plasma was found, the latter showing a relatively greater prolongation. It was reasoned that dicoumarin serves to hasten the process of destruction of prothrombin and that this is probably done by the reticuloendothelial system.

Studies on 5 patients receiving simultaneous doses of dicoumarin and quinone yielded results similar to those in patients receiving dicoumarin alone. It is concluded that the effects of quinone and dicoumarin are opposite but that they are not directly antagonistic. Dicoumarin probably produces the effect not only by the prohibition of the formation of prothrombin but also by facilitating its destruction. Thus, despite vitamin K therapy the bone marrow plasma contained a decreased amount of prothrombin as compared to peripheral plasma. This was probably due to active destruction of the prothrombin by the reticuloendothelium of the marrow.

The author arrives at the following conclusions:

1. Prothrombin is not produced by the reticuloendothelial system and therefore such production is not a function of the hepatic parenchyma.
2. Prothrombin is equally distributed in the sternal marrow and in the peripheral blood stream.
3. Vitamin K accelerates the production of prothrombin, and the excess which results is equally distributed in the marrow and the peripheral blood.
4. Dicoumarin causes a more pronounced decrease in prothrombin of the marrow than in the peripheral blood stream. The evidence is suggestive that this is due to the destruction of prothrombin, most likely by the reticuloendothelial system.
5. When dicoumarin is given simultaneously with synthetic vitamin K, even if the former is in relatively small amounts and the latter in massive quantities, the action of the dicoumarin usually predominates.

EDMUND R. DONOHUE, M.D.

Watson, C. J.: Some Newer Concepts of the Natural Derivatives of Hemoglobin. *Blood, J. Hemat.*, 1946, 1: 99.

The author states that protoporphyrin is the underlying porphyrin of the hemoglobin molecule. The name simply indicates that protoporphyrin is a representative or prototype of the various naturally occurring porphyrins insofar as its widespread occurrence and physiological significance are concerned. Protoporphyrin is the substance which binds the iron of the hemoglobin molecule. This was first established by the studies of Kammerer and others. The underlying porphyrin of the hemoglobin molecule is hemaporphyrin. The latter substance is formed when hemoglobin is treated with concentrated sulfuric acid, but it is an artificial compound not occurring naturally.

It has been an important question in the past as to whether protoporphyrin is intermediate in the pathway between hemoglobin and the bile pigments. It was formerly believed, probably because of the care with which hematin is formed in vitro by the treatment of hemoglobin with either acid or alkali, that

hematin, a ferric complex of protoporphyrin, was the first step in the transition to bile pigment. In recent years, Hamilton Fairley has shown that hematin is bound to some portion of the albumin fraction of the plasma protein when it is present in the circulating plasma in pathological states such as, for example, blackwater fever, severe liver disease, gas bacillus sepsis, and other conditions. The author notes that globin has approximately the same molecular weight and the same electrophoretic behavior as albumin, so that a hematin formed under natural conditions and still attached to globin would be expected to be associated with the albumin fraction. The term, methemalbumin, is used to designate this association. There is no reason to believe, however, that hematin or methemalbumin is a normal intermediary substance in the transition of hemoglobin to bilirubin.

In his summary and conclusions, the author states that the transition of hemoglobin to bile pigment, at least under normal conditions, is believed to occur via an intermediate biliverdin-globin-iron (verdo-hemoglobin) and not over the stages of hematin and protoporphyrin. It is probable that the next step is a reduction to bilirubin with a splitting off of iron. There is much reason to believe that the globin remains attached until the bilirubin passes through the liver cell, the bilirubin globin exhibiting a delayed or indirect van den Bergh reaction and not being excreted in the urine, and the sodium bilirubinate of the bile exhibiting a prompt (I') van den Bergh reaction and being readily excreted in the urine. The former type is characteristic of retention, the latter of regurgitation jaundice.

Bilirubin which is attached to its original globin is responsible for the delayed or indirect van den Bergh reaction. It may be due to the fact that bile is weakly alkaline, and it is not unlikely that the bilirubin in the bile is the sodium salt.

The appearance of bilirubin in the urine is believed to be related to the concentration in the blood of the I' or prompt bilirubin, rather than that of the total bilirubin. It is evident that the threshold may be considerably lower at the onset of jaundice, as, for example, in hepatitis, than during its defervescence. This undoubtedly accounts for the appearance of bilirubinuria prior to recognizable jaundice in certain instances, likewise for its presence in the cases of so called "hepatitis without jaundice." In retention jaundice, marked elevation of the total serum bilirubin is unassociated with bilirubinuria; in these cases the increase of bilirubin is mainly of the delayed or indirect reacting type. Further evidence is presented of the essential difference between the I' (or prompt) and the T minus I' (or delayed and indirect reacting) bilirubins. This consists of a change of the order of reaction at one minute after adding the diazonium salt. The normal upper limit of the I' bilirubin has been shown to be around 0.2 mgm. per 100 c.c.; figures well below this value are usually obtained.

Further experience with the erythrocyte protoporphyrin in the anemias has revealed that this determination, quite apart from its fundamental

interest, is at times of diagnostic value. Thus, in several instances a significant elevation of the erythrocyte protoporphyrin has indicated that the initial impression of pernicious anemia was incorrect, and has led to the search for other information. Conversely, a low normal value in the presence of anemia has often correctly indicated or confirmed the diagnosis of pernicious anemia. Marked elevations have aided in confirming the presence of iron deficiency and have given some insight into the degree of its severity and chronicity.

In conclusion the author states that in certain cases, high values for the erythrocyte protoporphyrin have suggested the possibility of heavy metal toxicity, the existence of which has been borne out by subsequent study. HERBERT F. THURSTON, M.D.

**Capovani, L.: Alterations in Normal and Decapsulated Kidneys Caused by the Transfusion of Heterogenous Blood** (Le alterazioni da trasfusione di sangue eterogeneo puro nei reni normali e nei reni decapsulati). *Arch. ital. chir.*, 1944, 66: 205.

The author transfused human blood into rabbits and studied the resulting changes in decapsulated

kidneys and in corresponding normal organs. In animals with intact kidneys he found alterations of the renal function in the form of anuria, oliguria, hemoglobinuria, cylindruria, and diminished excretion of urea.

The anatomopathological examination disclosed a degenerative nephropathy. The histological studies showed degenerative changes of the tubular epithelium, dilatation and infiltration of a part of the excretory tubuli, and the presence of hyaline and granular casts and exfoliated epithelium. The author assumes that such changes are caused by a toxic substance deriving from the plasma and disintegrated morphologic structures of the blood which has been transfused.

The decapsulated kidneys were larger and more voluminous than the intact kidneys, and the histological examination showed a more pronounced infiltration of the excretory system and more numerous hyaline casts as compared with the intact kidneys. The greater intensity of the lesions is probably caused by local changes which take place in the circulation in the decapsulated kidneys.

JOSEPH K. NARAY, M.D.

# SURGICAL TECHNIQUE

## OPERATIVE SURGERY AND TECHNIQUE; POSTOPERATIVE TREATMENT

Conway, H., and Coldwater, K. B.: *Principles in Reporative Plastic Surgery. Surgery*, 1946, 19: 437.

Problems in plastic surgery encountered in the Philippine campaign between October, 1944 to March, 1945 are discussed.

Transportation problems in vast Pacific distances influenced greatly the choice of procedure. Forty-nine per cent of the patients were seen in from 5 to 8 days after injury in this campaign, and 36 per cent were seen in from 21 to 55 days following injury in another campaign.

The authors discuss 468 secondary closures, 305 split-skin grafts, 46 small deep grafts, and 28 primary procedures involving the transplantation of flaps of skin and subcutaneous tissue. The final reconstructive surgery, of course, was to be done at a later time, the main consideration in this theater being one of either having the patient return to duty early, or treating him so as to minimize the transportation hazard while being sent to plastic centers in the United States.

Wounds which had been treated with frequent change of dressings were in far better condition than those which had been treated by the closed method. *Bacillus proteus*, *bacillus pyocyaneus*, and *staphylococcus* were the common contaminants. *Streptococci* were rarely found. In a series of 4,040 battle casualties, *clostridium welchii* were found in 37 cases.

Preoperative treatment consisted of wet dressings of a 1:3300 aqueous solution of azochloramide. These were changed at four hour intervals after preliminary removal of necrotic tissue. Occasional dermatitis resulting from this was treated with a mild astringent. The local application of penicillin was found to be a useless extravagance. In fact, penicillin dressings were followed by a striking increase in wound exudate and in the growth of gram negative organisms. Sulfonamide drugs were not used locally in wounds. Systematic administration of sulfadiazine or penicillin was limited to patients who were febrile or toxic, or whose wounds showed streptococci or evidence of spreading infection.

In the choice of operative procedure, secondary suture, whenever possible, unquestionably was the best method of closing war wounds, although unhealed wounds over 4 weeks of age were less suitable for closure. Secondary closures were contraindicated in the region of the elbow, the distal third of the forearm, and in the hand. Similar closure of wounds in the regions of the groin, knee, distal third of the leg, ankle, and foot was not likely to succeed.

Of the secondary closures, 85.7 per cent of the wounds healed completely, 7.6 per cent had partial

separation, and 6.7 per cent had complete failure. Pressure dressings were applied, and extremities were immobilized and elevated. Failures resulted from undue tension, or attempts to obtain cosmetic results with suture. Such procedures should never be used when the skin and fat at the margins of the wound are indurated.

Split thickness grafts were used in the treatment of 306 patients, with 86.6 per cent completely healing; 6.9 per cent were a partial failure, and 6.5 per cent, complete failure. In the vast majority of cases free split thickness grafts were used, and open dressings of fine mesh gauze covered with collodion. Saline dressings were applied and changed at four-hour intervals. The extremities were generally immobilized in plaster with a window at the operative site. Immobilization was discontinued in from the ninth to the twelfth day, and a pressure dressing substituted. Where plaster fixation was not feasible, skeletal or adhesive traction immobilization was found valuable.

The causes of failure were for the most part due to errors in surgical judgment, in the proper selection of the optimum time for surgery, and in the technique of postoperative care.

Small deep grafts approximately 0.7 cm. in diameter, closely placed, were thought very valuable in the covering of certain lesions in the groin, popliteal area, antecubital fossa, and over certain bony prominences. Pedicle flaps and temporary split grafts could be used only infrequently in the treatment of wounded soldiers at the time the authors had them under their care. LOUIS T. BYARS, M.D.

Greeley, P. W.: *The Plastic Correction of Superficial Vascular and Pigmented Nevi. Surgery*, 1946, 19: 467.

The author discusses the correction of vascular nevi, which he divides into the capillary and cavernous types. Each type may be found anywhere and may be of any size. The etiology is unknown. The treatment formerly consisted of carbon dioxide snow, radium, or x-ray, which even now functions well in simple lesions; but in the more complicated group excision should be carried out with closure of the defect, or the application of a properly selected skin graft. In some cases in which the defect is very large and closure is elected, this may be done in multiple stages.

The cavernous type of nevi occasionally progresses with age so that early treatment is the procedure of choice. Rupture and hemorrhage can result from neglect, as can chronic infection. These angiomas are best treated by surgical excision but oftentimes such treatment should be preceded by the injection of sclerosing fluids, partial ligation, or exposure to x-ray or radium, the thought being that the danger of hemorrhage can be minimized because of the

fibrosis which will result. As in the case of capillary nevi, these defects can be closed either by primary suture or by the application of skin grafts, or adjacent skin flaps.

Pigmented nevi are brownish colored lesions varying in shade from café au lait to deeper brown colors. The darker shades of nevi are more likely to take on malignant changes, whereas the large brownish growths, contrary to popular belief, seem to become malignant very rarely. The etiology has not been solved.

For the sake of safety, expediency, and the best cosmetic results, pigmented nevi should be excised, the deep brown colored nevi being excised widely and the adjacent skin edges closed. The larger tumors may be removed by excision and closure either in single or multiple stages, or by the use of a properly selected skin graft.

The author presents 17 cases which illustrate the various points mentioned in his article.

LOUIS T. BYARS, M.D.

Shaw, D. T., and Payne, R. L., Jr.: Repair of Surface Defects of the Upper Extremity. *Ann. Surg.*, 1946, 123: 705.

The selection of the proper type of replacement for surface defects of the upper extremity is dependent upon the amount and degree of tissue loss. Hence a procedure may be as simple as a scar excision or as extensive as a pedicle graft. Scar excision and the removal of foreign bodies, nonvital bone, and irreparably damaged tendon should be done at the time of replacement. Elevation of the extremity and mild pressure dressings are recommended for the prevention of edema and fibrosis. The hand and arm are splinted in the position of function. If damaged and denervated muscles are involved, a neutral position is maintained to prevent contracture. An open wound should be eliminated whenever possible even if it requires a thin split graft as a temporary dressing. Graft margins should be placed in conformity with Langer's lines.

The ideal method in the repair of surface defects is excision of scar tissue and closure by mobilization of the skin and subcutaneous tissues. This can be done in large defects of the arm and forearm by extensive undermining of the skin and splitting of the superficial fascia. Skin may be closed under tension provided the sutures are buried under the dermal layer. Cuticular sutures when used to close a wound under tension cut the skin and cause local necrosis and infection. Skin when closed under tension will relax readily and become mobile. The buried sutures may be either interrupted, inverted subcuticular, or continuous subcuticular with the stretch perpendicular to Langer's lines.

Pedicled grafts, flap and tube types, provide both skin and subcutaneous tissues for surface defects. They are also used to provide a vascular cover over tendons, bones, and joints. Pedicled grafts should be attached to surrounding tissue of normal vascularity. Rarely, a pedicled graft may be used primarily for

its subcutaneous tissue. The most suitable site for pedicled grafts providing both thick and thin skin, with or without hair, may be obtained from the lower thorax and abdomen. Direct abdominal flaps offer a quick method of replacing lost tissue. Either the donor area or the base of the flap may be left to granulate in until the time of division. Two flaps, delayed or direct, may be applied simultaneously to two areas. The vertically cut flaps give the best results because the superficial abdominal blood vessels have a vertical pattern. A double pedicled tube graft is not suitable for the forearm and hand except when there is limited pronation and supination in the forearm and lack of motion in the elbow. One stage single pedicled tubes are based inferiorly to include the superficial circumflex iliac or epigastric vein. The latter are especially adaptable for repair of defects of the hand and wrist. Under favorable circumstances when replacement is done, nerves may be sutured, areolar tissue wrapped about tendons, and capsulotomy or arthroplasty may be done. The loss of a side of a finger tip can be corrected by shortening the nail and distal phalanx, and rotation of a flap. When a finger must be amputated its skin may be made available for palmar or dorsum defects by longitudinal splitting of the skin. Z-plasties are recommended for the band type of contracture, the repair of finger webs, longitudinal scars of the fingers or palm, and contracted graft margins. Thick split grafts and full thickness grafts give less contracture than thin split grafts or small deep grafts. Thin full-thickness grafts are available from the lower abdomen, the medial surface of the arm, and the anterior medial thigh.

BENJAMIN G. P. SHAPIROFF, M.D.

#### ANTISEPTIC SURGERY; TREATMENT OF WOUNDS AND INFECTIONS

Kreyberg, L.: Tissue Damage Due to Cold. *Lancet*, Lond., 1946, 1: 338.

This article represents an attempt to summarize and discuss some of the effects of exposure to low temperature, with special reference to the development of necrosis in frostbite and trench foot. The initial reactions to cold are a purely physiological adjustment, and it is not until exposure to cold has lasted for a considerable time that the reactions of the tissues become pathological. Three types of pathological reactions are described: (1) those after a short exposure to moderate cold; (2) those following freezing to ice and return to normal temperature; and (3) those after prolonged exposure to moderate cold not involving freezing to ice (trench foot).

With short exposure to moderate cold, nothing beyond the initial physiological reaction is seen during the exposure. No reaction beyond moderate pain during the exposure indicates tissue damage. Exposure for several hours to very cold air, or for minutes or hours to cold water, may produce the following reaction after the return of the exposed

part to normal surroundings: the exposed part is flushed red with slight pulsation and, for a brief period, raised temperature; the skin is thicker and slightly edematous, and sometimes there is itching, burning, or moderate pain. The clinical picture corresponds exactly with that of moderate sunburn or scald. This is what clinicians call first-degree frostbite. Slight pigmentation may be the end-result. If the exposure has been longer or to a lower temperature, there may be blister formation and a generally more severe reaction. This is clinically known as second-degree frostbite, and, likewise, is very similar to sun and heat reactions. It must be emphasized that light and heat may add to the effect of exposure to cold.

With freezing of the tissues to ice, the ice crystals form on the surface and in the skin. On return to normal environmental temperature, thawing sets in; the whiteness of the frozen skin disappears and is closely followed by a rich red color. In a few minutes a well marked edema can be observed, if the thawing takes place in a heated room. Edema develops much more slowly if thawing is done gently out of doors or in a cold room. The prominent features of the tissues after thawing are hyperemia and edema, which may be severe and accompanied by wheals and blisters, raised temperature, and necrosis. There is a pronounced increase in permeability of the walls of the minute vessels. The series of events that characterizes the intravascular reaction is: cohesion of the blood cells, in the period of development of stasis; intravascular blood cell necrosis, in the next phase; and intravascular hyaline mass formation, as the end result of degeneration of the blood cells. This reaction is quite different from the secondary true thrombosis that may develop at a later stage in or around the tissues undergoing necrosis. The questions arise as to how much of the necrosis is caused by direct action of the cold, and how much is caused secondarily as a result of the vascular stasis. The author cites evidence indicating that freezing of tissues to ice is not necessarily a deadly process like heat coagulation. It has been shown experimentally that the necrosis follows a vascular deficiency caused by a blocking of the blood vessels by red cells.

During prolonged cooling two forms of damage proceed *pari passu*: (1) that due to cooling, and (2) that due to lack of oxygen. One of the first symptoms of prolonged cooling is an increased transudation, with the formation of edema. The edema is augmented when the subject is standing or immobilized (increased hydrostatic pressure), when the limb is constricted (venous congestion), or when the physical condition is poor (hunger, reduced protein and reduced colloid pressure, cardiac or vascular disease). A vicious circle is soon established, with increasing local tissue damage and increased permeability of the minute vessels. The cold prevents a too rapid development, partly by slowing down all activities and partly by the prolonged contraction of the arteries and arterioles. Accordingly, the foot presented at admission is

whitish, bluish, and edematous, with little or no pulsation in the larger arteries. The local edema and the spasm of the arteries are dominant clinical features. The minute vessels may again show mainly dilatation (blue) partly obscured by the severe edema. When the patient is brought under treatment in a room with a higher temperature, the first clinical reaction is re-establishment of the arterial blood flow. The spasm goes, the heat returns, and the skin becomes more or less deep red. The reaction is probably twofold: a reactive hyperemia in its specific sense, and an inflammatory hyperemia caused by tissue damage. Unless the case is of long standing, the tissues in the foot are not dead when the patient is brought under treatment. In trench foot it is still more evident than after freezing to ice that the necrosis of tissues takes considerable time and is not inevitable, and that incorrect treatment may encourage necrosis.

The practical application of these views for the treatment of injuries due to cold is to place frostbite, freezing, trench foot, and allied conditions on the same basis. The return to normal temperature and normal circulation involves the danger of the development of stasis. Medical assistance is of most importance when the tissue is in the stage of prestasis. The principles of such treatment have been established empirically:

1. Avoid rapid heating and avoid rubbing.
2. Place the limb in an elevated position and observe the vascular reaction. If the vascular response is rapid and fulminating, with raised temperature of the skin, the limb should be moderately cooled but not returned to an injurious low temperature with ice packs or similar treatment.
3. Keep the skin aired and dry to avoid maceration of the epidermis. JOHN L. LINDQVIST, M.D.

**Bourdillon, R. B., and Colebrook, L.: Air Hygiene in Dressing Rooms for Burns or Major Wounds. *Lancet*, Lond., 1946, 1: 561, 597.**

The bacterial content of the air in the dressing room of a burns unit has been studied with especial reference to the danger of transmitting airborne infection from one patient to the next.

To reduce this danger a forced ventilation plant was installed; this gave highly filtered air at about 10 changes per hour, which later was raised to 20 changes per hour.

A very low incidence of added infections among the burned patients was maintained during 6 months of this study, and analysis suggests that infection by streptococci was not transmitted in any instance in the course of dressing. It is not claimed that this was entirely due to the special provision made for dressing patients in clean air, but it is considered probable that this played an important part.

This result, coupled with extensive studies on the rate of disappearance of air borne organisms from the room, leads the authors to conclude that a supply of fairly clean air equal to 10 changes per hour is adequate for reasonable safety, provided that an inter-



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3. Keep the skin aired and dry to avoid maceration of the epidermis. JOHN L. LINNQUIST, M.D.

Bourdillon, R. B., and Colebrook, L.: Air Hygiene in Dressing Rooms for Burns or Major Wounds. *Lancet*, Lond., 1946, 1: 561, 597.

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This result, coupled with extensive studies on the rate of disappearance of air borne organisms from the room, leads the authors to conclude that a supply of fairly clean air equal to 10 changes per hour is adequate for reasonable safety, provided that an inter-

val of at least 5 minutes is enforced between the exit of one patient and the entry of the next, and that unsoiled blankets are not exposed in the dressing room. However, an air supply of from 20 to 30 changes per hour is considered preferable, when practicable.

Standards of air hygiene are proposed as being practicable and desirable for theaters and dressing rooms. It is suggested that hospitals should satisfy themselves about the purity of the air in their operating theaters and dressing stations just as they do of their water and milk supplies.

A new technique of sampling air for bacteria is described; this permits accurate determination of the moments at which clouds of bacteria are liberated. It has shown that large numbers of air borne bacteria are often liberated when dry bandages and wool are removed from a patient. These clouds sometimes contain many pathogens. Large clouds may also be liberated by the movement of pajamas or other bed clothes that have been used.

Data are given which confirm the view that unsoiled blankets should not be allowed in any surgical dressing room or theater. JOSEPH GASTER, M.D.

Rountree, P. M., and Armytage, J. E.: Hospital Blankets as a Source of Infection. *Med. J. Australia*, 1946, 1: 503.

The authors' study of the flora of hospital wards was prompted by the findings in other countries, the high incidence of streptococcal infections in Australia, and the occasional occurrence of hemolytic streptococcal infections in surgical wounds.

In a preliminary survey during the winter of 1944, hemolytic streptococci were found in 88 of 122 dust samples cultured from several surgical and ear, nose, and throat wards. The majority of the streptococci were in the Lancefield's A group. Hemolytic streptococci were grown from 35 of 72 throat cultures taken from patients and personnel. A considerable number of persons examined carried group A streptococci without symptoms. A composite dust sample of ward sweepings yielded 250,000 hemolytic streptococci per gram and large numbers of coagulase positive staphylococci.

The present survey carried out during the winter of 1945 investigated the bacterial flora of bed clothes and correlated these findings with the presence or absence of hemolytic streptococci in the wounds or upper respiratory passages of the patients. It also included the examination of dust and air samples from the surgical ward.

The apparatus used to sample the air and blankets was a flow meter similar to that used by Lemon. The apparatus is fully described and its use explained.

In the ear, nose, and throat ward, 3 of 8 throat swabs yielded hemolytic streptococci, and these organisms were found in 2 nasal swabs. Seven of the 37 throat, but none of the nasal swabs taken from the surgical ward were positive for hemolytic streptococci.

Ten of the 24 wounds examined were considered to be infected at or after the operation. The organisms in 10 cases were the staphylococcus aureus, and in 2 the hemolytic streptococci.

Of the 47 blankets examined, 31 yielded hemolytic streptococci. Cultures of 19 of 24 blankets from the male surgical ward and only 3 of 13 from the female ward revealed hemolytic streptococci. The organisms sucked from the blankets varied from 14,400 to 7,344,000 per cubic foot of air. The lowest counts were obtained in new unwashed blankets.

Nine of 16 samples of floor dust and fluff from the surgical ward yielded hemolytic streptococci with a high incidence of group A strains. Forty-four colonies of streptococci were isolated from the male side of the ward as compared to only 1 from the female side. The dust from the floor of the surgical dressing room yielded profuse growths of hemolytic streptococci.

Air samples taken before, during, and after bed making showed a rise in bacterial content of the air during bed making. However, no hemolytic streptococci were isolated, probably because samples were collected from areas near beds from which no streptococci were recovered either from the blankets or the occupants. In the previous winter hemolytic streptococci were grown on 9 of 10 plates exposed during bed making.

This survey showed the presence of considerable numbers of hemolytic streptococci in the dust samples of surgical and ear, nose, and throat wards. It also established the fact that dangerous wound pathogens—namely hemolytic streptococci—were present in the blankets. In 5 cases with wounds contaminated by hemolytic streptococci, the numbers of streptococci isolated from the blankets were considerably higher than those from other blankets.

With 1 exception, the blankets of the 10 patients with hemolytic streptococci on their throat cultures, yielded hemolytic streptococci.

There was a high incidence of wound infection—many cases with staphylococci. The authors suggest further investigation with phage typing of the staphylococci.

The problem of air-borne infection must be dealt with by using aseptic techniques in dressing surgical wounds and oiling floors to lay the dust.

Blanket laundering is adequate for sterilization but the frequency of washing is insufficient.

The oiling of blankets reduces the number of infected dust particles in the air, but there is no evidence that it prevents possible direct infection from blanket to wound. Further investigations of the measures necessary to overcome this problem are required.

ROBERT R. BIGELOW, M.D.

Rountree, P. M.: The Treatment of Hospital Blankets with Oil Emulsions and the Bactericidal Action of "Fizanol C" (Cetyl Pyridinium Bromide). *Med. J. Australia*, 1946, 1: 539.

The author reports the results of an experimental study of the bactericidal effect of a chemical agent,

cetyl pyridinium bromide, "fixanol C", on a group of pathogenic organisms found on hospital blankets.

Previous studies by the author in 1946 showed that hospital blankets carried a heavy load of micro-organisms, and that blankets should be regarded as dangerous sources of bacteria causing wound infections.

The bacteriostatic and bactericidal action of fixanol in oil-water emulsions sprayed onto fluff, and the bactericidal power of fixanol in oil-water emulsions used to impregnate blankets, were determined.

Ten species of gram-positive organisms, including a number of different strains of hemolytic streptococci, pneumococci, and staphylococci, were examined. With the exception of one strain of *Bacillus subtilis*, one strain of *Clostridium histolyticum*, and one strain of *Corynebacterium diphtheriae*, the concentration of fixanol inhibiting growth was either 1 in 200,000 or 1 in 400,000, 28 strains in all being tested. The culture of *Clostridium histolyticum* used was inhibited by a 1 in 100,000 dilution and the strain of *Bacillus subtilis* by a 1 in 10,000 dilution. The strain of *Corynebacterium diphtheriae* was inhibited by a dilution of 1 in 32,000. The results indicate that fixanol possesses a high degree of bacteriostatic activity against gram-positive organisms.

A low order of activity was shown against the 12 species of gram-negative organisms tested—dilutions ranging from 1 in 1,000 to 1 in 10,000 being the highest concentration which inhibited growth. There were two exceptions to this—*Shigella paradyseriae* Flexner, two strains of which were inhibited by a concentration of 1 to 100,000, and *Neisseria gonorrhoeae*, three freshly isolated strains of which were inhibited by a concentration of 1 to 100,000.

Fixanol in vitro in a concentration of 1 in 5,000 showed bactericidal activity against various strains of hemolytic streptococci, *Staphylococcus aureus*, *Proteus vulgaris*, and *Mycobacterium phlei*.

Fixanol C, the active principle of which is cetyl pyridinium bromide, is an active bactericide against a large number of gram-positive and gram-negative organisms found on hospital blankets. Fixanol C, when incorporated in an oil-water emulsion and sprayed onto hemolytic streptococci dried on sterile fluff, rapidly kills these bacteria. Fixanol C, when impregnated into blankets in a concentration of 1 to 800, imparts an efficient bactericidal action to blankets so treated. Blankets treated with fixanol C and oil retain their bactericidal power for periods of at least 3 months.

It is realized that cross infection in hospital wards depends on many factors, and it is not suggested that an oil, plus antiseptic, treatment of blankets will eliminate it. However, it is considered that such treatment should substantially reduce the load of bacteria added to the air during bed-making, and should also reduce the chances that wound infection would be transmitted from infected blankets to patients.

The use of fixanol to impregnate oiled blankets at a concentration of 1 to 800 should prove to be of

value in the control of cross infection in hospital wards, in the nursing of both surgical patients and patients with infectious diseases. Blankets treated in this manner have only a slightly oily texture and no perceptible odor.

JOHN H. MOHARDT, M.D.

Stammers, F.A.R., MacLennan, J. D., Macfarlane, M., Hartley, Sir P., and Evans, D. G.: Discussion on the Toxemia of Gas Gangrene. *Proc. R. Soc. M., Lond.*, 1946, 39: 291.

Gas gangrene is discussed in detail, and the experience of British surgeons with it is reported in this article. Although almost nothing was known of the disease before 1914, much accurate knowledge was accumulated during and after World War I.

Gas gangrene is an infection of devitalized muscle by gas-forming organisms, though fascia, blood clot, and brain are susceptible. The mere presence of clostridia in a wound is not sufficient. Defective blood supply, damaged muscle, and clostridia are the essential factors, and major muscle wounds such as those of the buttocks, thigh, calf, and scapuloaxillary regions are especially liable to gas infections.

Missiles, such as jagged pieces of shell, mine and mortar, cause more disruption of tissue than do bullets, and indriven pieces of dirty clothing or equipment are especially damaging. Anything affecting the blood supply, directly or indirectly, encourages the disease. Injury to blood vessels, tourniquets, tight bandaging, incorrectly applied splints, and ambulance journeys over rough roads all embarrass the blood supply, but the general lowering of the blood pressure resulting from hemorrhage, shock, dehydration, exposure to wet and cold, further contributes to the liability of gas gangrene.

Of special significance is the observation from all fronts that something is absorbed from damaged muscle that leads to a prolonged lowering of blood pressure, which later will encourage gas gangrene if clostridia be present. There is a close resemblance between the case of gas gangrene toxemia and the case of absorption of the products of lacerated muscle. A report by MacFarlane and MacLennan (January, 1945) suggests that part of the syndrome of gas gangrene toxemia was due to the absorption of the products of breakdown of muscle resulting from clostridial infection of it.

Time is an important factor. It has been shown repeatedly that infection in wounds remains relatively superficial for the first 8 to 12 hours, but that after this time the deeper tissues become involved. Delay in applying surgical treatment until after this optimum interval encourages sepsis and the risk of gas gangrene.

From the surgical point of view, cases may be divided into the established case (as, for instance, in men who could not be rescued for many hours), an unexpected finding at operation, or a complication developing after the first operation—a very rare event. Patients whose collection had been delayed were admitted prostrated, with cold, blue, clammy extremities, running pulse, the wounded part being

painful, swollen, livid, or mottled, and becoming plum-colored from hemolysis. Gas might or might not be present; it could often be detected with varying pressure of the stethoscope, earlier or more readily than with the fingers. If muscle was exposed it was dry and dull, and discharges were no more than a foul smelling thin fluid. Sometimes jaundice developed. In the case discovered unexpectedly at operation, one or more affected muscles of a group, or part only of one muscle belly, with clear demarcation between normal and abnormal, are discovered during exploration of the wound. The affected muscles may be salmon pink or red, and only in extreme cases black and diffuent, and in any case they do not contract or bleed when cut. The surrounding tissues may be normal or distended with yellow edema, and fine gas bubbles may be seen in both muscle and intermuscular septa. In the case developing after operation, the onset is sudden. There is local pain, malaise, rising temperature and pulse, and sometimes vomiting, but the outstanding and most characteristic feature is the toxemia. From a relatively normal individual, the patient will within a few hours become anxious, euphoric, or wildly excited, and the pulse rapidly deteriorates. Such a patient is near the end, and he may reach for a drink and die in the act. In the earlier days of the war, much importance was attached to the development of pain, but during the last 12 months in Italy, many surgeons remarked on the absence of pain, probably the consequence of better and earlier surgery, aided by penicillin therapy in the control of secondary infection.

Less than 50 per cent of patients develop gas. In the past, unnecessary amputations have been performed because of the presence of emphysema locally in the absence of the clinical picture. Muscle fibers, cut suddenly by a sharp fragment of metal, spring apart and, like the piston of a syringe, may aspirate air through the skin wound into the gap. The air disseminates rapidly and may be diagnosed as gas. The absence of evidence of toxemia should obviate this error.

The essentials of treatment are early, adequate surgery, blood, blood plasma, intravenous fluids, antitoxin, penicillin, and adequate immobilization and protection of the wound against secondary infection.

The treatment of gas gangrene is primarily preventive and the disease can be almost eliminated by proper medical organization. Every surgical case should receive treatment within 2 to 6 hours of wounding, and all the remainder within 12 hours. At the earliest possible moment all major wounds were given sufficient antitoxin to contain 8,000 units of anticlostridial welchii. All major muscle wounds—calf, thigh, buttock, and scapuloaxillary region—were regarded as top priority cases, but even small muscle wounds were treated by careful excision too. Wounds were dressed and carefully splinted at the earliest moment practicable. Because of the effect on blood pressure of massive injury to muscles of

over 3 hours standing, too much time was not spent on resuscitation; surgical intervention was considered the essential procedure.

Adequate incisions are needed for careful exploration of the wound. All foreign material must be sought for and removed, the wound carefully irrigated with saline solution, and all affected muscle excised. The complete muscle belly is excised from origin to insertion when practicable, though in large muscles like the adductor magnus it may be necessary to remove only a part of it. All discolored muscle, and muscle that does not bleed or contract when cut, should be removed. Deep fasciae are incised transversely and longitudinally for decompression and drainage. The wound is frosted heavily with penicillin powder, and the skin is left open but dressed with dry gauze. Enormous amounts of muscle may have to be sacrificed (as, for instance, the entire gluteal muscles), and a limb may be so disorganized as to require immediate amputation, but the amputation rate has declined in proportion to the application of better prophylactic surgery. These patients require blood plasma and fluids. This should include one bottle of plasma daily to replenish protein, and blood should be given according to hemoglobin determinations. The volume to be administered was determined by Van Slyke's copper sulfate test. At the end of operation 100,000 units of antitoxin were injected and the patients were placed on a schedule of 15,000 units of penicillin every 3 hours for about 3 to 7 days. The discussant is not convinced that penicillin affected the clostridial infection but is sure that penicillin controlled secondary pyogenic infection.

In discussing the pathogenesis, MacLennan and MacFarlane emphasize the importance of clostridia welchii in this disease and favor the view that the alpha-toxin is the component of prime importance and that the others of the many enzymes elaborated by clostridia welchii play a subsidiary role in the intense necrosis and tissue reactions seen in gas gangrene. Several causes of the toxemia of gas gangrene are postulated: (1) action of the specific bacterial toxin on vital organs; (2) production of nonspecific toxic substances by the infecting organism; and (3) toxemia due to ischemic muscles. A component of importance in the toxemia is the nonhemolytic toxic factor, not neutralized by antitoxin and derived from disintegrating muscles, as may be observed in severe muscle trauma, crush syndrome, and related states.

The decline in mortality, from over 50 per cent in Italy in 1940, to 30 per cent in 1944, is attributed to intensive use of antitoxin and improved surgery. With the best treatment possible, including penicillin, the death rate remained about 25 per cent. The fact that with the best treatment possible the death rate remained about 25 per cent, indicates the existence of another cause of toxemia in addition to the bacterial toxin, and it is suggested that this may be the added toxemia of disintegrating muscle.

JOHN H. MORGENTHAU, M.D.

Lemierre, A., Reilly, J., Morin, M., and Rathery, M.: The Effect of Penicillin on Septicemia Caused by Anaerobic Microbes (Action de la pénicilline dans quelques septicémies à microbes anaérobies). *Presse méd.*, 1946, 54: 49.

The authors employed penicillin in 9 patients with septicemia caused by the bacillus perfringens or the bacillus funduliformis.

Although, as a rule, an infection caused by the first mentioned micro-organism is nearly always fatal, in 2 women the administration of penicillin suppressed the septicemia nearly immediately and the bacteriologic examination of the blood, urine, and lochia gave negative results. However, of 3 patients suffering from a septicemia caused by the bacillus perfringens 2 died. The fatal outcome was probably due to the colon bacilli which are resistant to penicillin.

In patients with tonsillitis, especially the phlegmonous type, the early administration of penicillin prevents secondary localization of the infection, e.g., pulmonary infarcts or arthritis.

The authors found that certain species of bacillus funduliformis respond well to the treatment with penicillin, while others are apparently resistant to the drug.

On the whole, the beneficial effect of penicillin is more striking in the treatment of septicemia caused

by the bacillus funduliformis than in postabortum cases of septicemia for which the bacillus perfringens is responsible.

JOSEPH K. NARAT, M.D.

### ANESTHESIA

Corlette, C. E.: Spinal Anesthesia and Chloroform; A Comparison of Mortality. *Med. J. Australia*, 1946, 1: 545.

The author has made a survey of the literature to find the recorded over-all mortality of spinal anesthesia and to compare it with that of chloroform anesthesia. The results offer food for thought and matter for much consideration.

If two collections of cases are added, there is a total of 35,612 administrations of chloroform with 32 deaths. This is a mortality rate of 8.9 in 10,000.

Three series which include a total of 20,012 cases of spinal anesthesia with 54 deaths are reviewed. This is a mortality rate of 26.9 in 10,000, three times the death rate calculated from the chloroform anesthetics.

If the statistics are soundly based, the chloroform anesthesia of 50 years ago was at least twice as safe as the spinal anesthesia, and, on the average, it was probably three times as safe.

MARY FRANCES POE, M.D.

# PHYSICOCHEMICAL METHODS IN SURGERY

## ROENTGENOLOGY

Neuhauser, E. B. D.: Roentgen Changes Associated with Pancreatic Insufficiency in Early Life. *Radiology*, 1946, 46: 319.

The author calls attention to the increasing recognition of pancreatic fibrosis as a cause of death in infants and young children, and cites the records of the Infant's and Children's Hospital of Boston, Massachusetts, in the year 1942 as showing that 12 per cent of the autopsied cases exhibit a significant degree of pancreatic fibrosis. He bases this article on more than 50 cases of this disease studied there.

The clinical and pathological findings of the disease are briefly reviewed with stress on Farber's work. Pancreatic fibrosis in infants may be due to some local process such as atresia or stenosis of the pancreatic ducts, or duct obstruction due to an annular pancreas, but in the majority of cases it is regarded as but one manifestation of a widespread disturbance in which there is failure of formation or of liberation of pancreatic enzymes and an alteration in the physical character of secretions from many organs, including glands of the trachea, bronchi, and intestinal tract.

If the reduction of pancreatic enzyme activity occurs before birth a physical alteration in meconium causes it to have a sticky mucilaginous quality which may lead to obstruction of the ileum and colon. Infants so affected are usually admitted to the hospital in the first week of life with signs and symptoms of intestinal obstruction, and frequently the roentgen findings admit of no more specific diagnosis than small bowel obstruction of undetermined origin, with perhaps a rough localization of the region involved. However, in some of the infants abdominal films have shown minute bubbles of gas scattered throughout the distal small bowel with some reduction of bowel caliber in this region as compared with the gas distended more proximal bowel. The author believes this appearance is due to the fact that gas bubbles are forced into an obstructing mass of abnormally tenacious meconium and therefore diagnostic of meconium ileus. He has not seen this pattern in any other condition of the newborn. In the last 10 cases of meconium ileus at this hospital the correct diagnosis was made roentgenologically in 4.

Disturbance in the motor pattern of the bowel after a barium meal was not recognizable in cases of pancreatic fibrosis in young infants, as the pattern is known to vary widely in apparently normal individuals at this early age. In some of the older infants showing the nutritional failure that is so prominent a feature of the disease, there was evidence of bowel hypertonicity and segmental dilatation with clumping and discontinuity of the barium column, but only rarely did the rugal folds

of the duodenum and jejunum appear coarsened in the manner encountered by Golden on the examination of older children and adults with nutritional deficiency states.

If pancreatic fibrosis is part of a generalized disease process, there is almost always evidence of chronic pulmonary disease, which in its early stage appears to be due to bronchial obstruction produced by the thick, glairy tenacious character of the tracheobronchial secretions. This stage is manifested roentgenologically by flattening and depression of the diaphragm, increased pulmonary radiolucency even in expiration, and widening of the intercostal spaces which is indicative of obstructive emphysema. The emphysema tends to be patchy, interspersed with lobular areas of atelectasis.

In the later stages of the disease pulmonary infection ensues and the roentgen appearance of the lungs changes sharply. The hilar shadows become markedly accentuated, and lines and patches of increased density cast by peribronchial pneumonic infiltrate radiate from them. Bronchiectasis develops. The end stage shows evidence of long standing pulmonary disease characterized by emphysema, atelectasis, fibrosis, and widespread infection involving all lobes but not, in the author's experience, the pleura. The author believes that this appearance, although not pathognomonic, is sufficient to suggest a diagnosis of pancreatic fibrosis in these young children, subject to confirmation by examination of the duodenal content for a reduction in the pancreatic enzymes. LILIAN DONALDSON, M.D.

Holt, J. F.: The Roentgen Diagnosis of Pancreatic Cyst. *Radiology*, 1946, 46: 319.

The author briefly summarizes the roentgen findings in cyst of the pancreas as revealed by a brief review of the literature and the observation of 23 patients who had had surgical treatment for pancreatic cyst at University Hospital, Ann Arbor, Michigan. The roentgen appearance, of course, varies according to the size of the cyst and the region of the pancreas from which it arises. Occasionally the cyst is visible as a soft tissue mass in films of the abdomen, but more frequently it reveals its presence indirectly by the pressure defects it produces in the barium filled stomach, proximal small bowel, and colon.

Cysts arising in the head of the pancreas may produce widening of the duodenal loop with little or no deformity of the stomach, whereas cysts of the body of the pancreas usually displace the stomach anterosuperiorly, with variable associated distortion of the proximal small bowel. Occasionally, cysts of the body may present superiorly and medially to the stomach which results in wide smooth indentation of the lesser curvature. The more common cyst of the tail of the pancreas, on the other hand, fre-

quently causes smooth rounded indentation of the upper or midportion of the greater curvature of the body of the stomach and lateral views show the stomach displaced anteriorly. In addition, the duodenojejunal flexure is displaced downward and the splenic flexure of the colon may be depressed or indented along its medial aspect. Of the 13 patients treated at University Hospital, 7 had a cyst arising in the tail of the pancreas, and films showed this deformity of the greater curvature of the stomach.

In the differential diagnosis, enlarged spleen, splenic cyst, mesenteric or omental cyst, and retroperitoneal neoplasm might conceivably produce such a deformity of the greater curvature of the stomach, but search of the files at University Hospital for such extra-alimentary masses revealed only 2 instances—a congenital cyst of wolffian body origin, and a neoplasm of the lower pole of the left kidney (identified by pyelography), which caused both greater curvature deformity and anterior displacement of the stomach.

The author therefore believes that these findings encountered in conjunction with a rounded ballotable, freely movable mass in the left upper quadrant of the abdomen enable the roentgenologist to make a diagnosis of pancreatic cyst with reasonable assurance and surmise in what portion of the pancreas it is located. The author does not discuss the findings in carcinoma of the pancreas.

LILIAN DONALDSON, M.D.

Dell, J. M., Jr., and Klinefelter, H. F., Jr.: Roentgen Studies of the Spleen. *Am. J. M. Sc.*, 1946, 211: 437.

During the last 18 months the authors made routine roentgen studies of the spleen in 300 patients in an Army General Hospital. In 50 per cent the spleen was enlarged, mostly due to malaria, and the other 50 per cent, which acted as a control group, consisted of neuropsychiatric, general medical and surgical patients.

The technique was very simple. Without any preliminary preparation, posteroanterior roentgenograms were made on an empty stomach. The central ray was directed through a point halfway between the midline and the left lateral chest wall, three finger breadths below the ensiform cartilage. The exposure factors were 100 milliamperes, 0.5 second, 36 inch skin target distance, Potter-Bucky diaphragm, and a kilovoltage varying with the thickness of the patient, but on an average from 6 to 8 kilovolts less than in the standard stomach technique.

The size of the spleen was estimated on the basis of its own measurable dimensions and a comparison with the size of the left kidney. Anatomically, the normal spleen of an adult is about 12 centimeters in length, 7 centimeters in breadth, and 3 to 4 centimeters in thickness, and the normal kidney 11½ centimeters in length, 5 to 7½ centimeters in breadth, and 2½ to 3 centimeters in thickness. Because of the fact that in the above described projection the magnification of the kidney is greater than

TABLE I.—A SUMMARY OF CRITERIA USED

Interpretation	Width	Density
Normal . . . . .	Less than 5 cm 5 to 5.5 cm.	Normal or increased Normal
Questionably enlarged	5 to 5.5 cm 5.5 to 6 cm	Increased Normal
Enlarged . . . . .	5.5 to 6 cm More than 6 cm.	Increased Normal or increased

Any spleen less than 85 per cent of the size of the kidney is not enlarged; any spleen more than 85 per cent of the size of the kidney is enlarged.

that of the spleen, the authors arbitrarily considered any spleen which is more than 85 per cent of the size of the kidney as enlarged.

Some difficulty was encountered in measuring the dimensions of the spleen proper, since, due to the oblique position, the roentgen shadow represents a combination of the anatomic breadth and thickness. The authors measured the width at the broadest possible point, which usually is just below the hilus, to the outer border of the spleen when this was visible, or to the internal surface of the ribs when the border was not visible. Since the spleen is rarely visualized in its entire length, this dimension could not be measured.

Rotation of the spleen on its long axis alters its width; therefore the authors found it necessary to consider also the density of the spleen. This was done by comparing it with the density of the lower half of the left kidney. The density of the spleen was regarded as increased when found greater than that of the normal kidney.

The criteria established are presented in Table I.

In a further study, the authors found no diurnal variation in the size of the spleen or any change due to the ingestion of food or moderate activity. The subcutaneous injection of adrenalin, however, resulted within 5 to 15 minutes in a definite decrease in the size of the spleen.

The conclusion is reached that the roentgen examination of the spleen is a valuable method. Many palpable spleens are not enlarged and many enlarged spleens are not palpable.

T. LEUCUTH, M.D.

Meschan, I.: A Radiographic Analysis of Spondylolisthesis. *Med. J. Australia*, 1946, 1: 465.

Spondylolisthesis is due to a defect in the isthmus of the articular processes. The defect is the result of trauma early in life or is due to lack of ossification of the isthmus. Trauma, sooner or later, invariably aggravates the condition.

The defect is best seen in the oblique views at an angle of 45 degrees. At an army base, 11.7 per cent of 520 roentgen examinations of the lumbosacral area revealed defects of the pars interarticularis and in two-thirds of this number the defects were bilateral.

The mechanism of spondylolisthesis takes place in an arc fashion, whereby the inferior part of the vertebra moves forward while the superior apophyseal joint acts as a pivot.



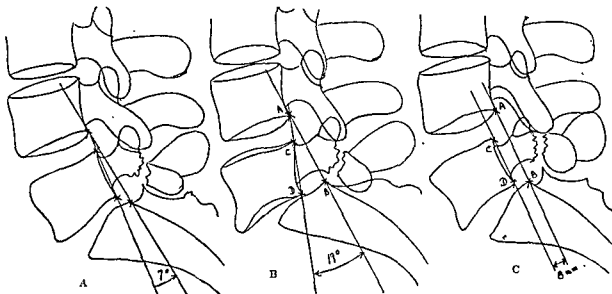


Fig. 1 Tracings of roentgenographs of subjects with spondylolisthesis; the lines either intersect above the fifth lumbar vertebra and form an angle exceeding 3 degrees,

as shown in (A) and (B), or remain parallel, but are more than 3 mm. apart as in (C).

The lateral roentgenogram is most accurate for detecting spondylolisthesis. The degree of displacement is measured by plotting lines between the inferior posterior border of the vertebrae above the involved one to the posterior superior edge of the vertebrae below the one in question (usually the first sacral), and another line from the posterior superior to the posterior inferior border of the involved vertebra. The two lines are close together and may cross above or below the involved vertebra; the separation angle is never above 3 degrees, nor is the separation of both lines, when parallel, more than 4 mm. In spondylolisthesis the separation angle is more than 3 degrees (from 12 to 16) and the parallel lines are more than 4 mm.

Stability of the vertebra is determined by means of upright films taken during weight bearing and in flexion and extension.

With this criterion, a defect of the isthmus was found in 55 of 520 patients whose lumbosacral spine was examined. All of the defects were in the lumbar vertebra except 1, which was found in the twelfth dorsal vertebra. Forty-two patients had bilateral defects; of this number, 62 per cent had definite vertebral displacement, and 19 per cent had borderline vertebral displacement, and 19 per cent showed no displacement. Stability tests were done on 26 patients with roentgen evidence of spondylolisthesis, and in 14 cases instability was present. Anterior slipping of the vertebral body was interpreted to be the result of undue strain on the anterior spinous ligaments. There was no correlation between the degree of vertebral displacement and stability. Stability tests should be done in all cases of spondylolisthesis.

MAURICE D. SACHS, M.D.

## RADIUM

Windeyer, B. W., Nuttall, J. R., Splers, F. W., Stewart, F. S., and Others: Symposium—Dosage Control in Interstitial Radium Therapy. *Brit. J. Radiol.*, 1946, 19: 133.

With the advent of radium as a therapeutic agent, several problems were immediately presented:

1. With the use of glass radon seeds, necrosis was found in the immediate area. (It was obvious that a better quality ray was needed.)
2. With the help of physicists, it was found that a more even distribution of radiation could be brought about by placement of needles of tubes around the periphery of the tumor, or, interstitially, approximately 1 cm. apart.
3. More accurate knowledge was found to be needed of tumor types and sites, and their response to radiation, in order to judge better the amount to be given.

In addition, the following problems must be considered and solved:

1. Difficulty of radium accessibility to tumor.
2. Tumors friable, so that needles move in tumor.
3. If inserted into a taut lesion, radium needles' position variable with the release of tension on lesion.
4. Correlation of kind of radium implants with the type of tumor.
5. Radium position dependent on movement of patient.

In order to control these sources of error, x-ray films should be taken in at least two planes with radium in position; also, a better method of radium implantation and a better method of estimating necessary tumor dosages are required.

An alternate method of demonstrating radium implantation in estimating tumor dosage may be used by taking two exposures on one film and shifting the tube for the second exposure.

Physicist and radiation therapist should work together in close harmony in order to achieve greater accuracy in the implantation of radium. All available methods which will be of aid to the physician should be used.

The therapeutic efficacy of radium and x-ray therapy in neoplasms is dependent on a minimal lethal tumor dose over a correct period of time. Planned treatments should call for a minimal, maximum, and general average tumor dose.

The difficulties of radium implantation are discussed. Inasmuch as it is difficult to insert radium needles parallel to each other, especially if the tumor contour is irregular, many devices have been tried; however, none has been entirely satisfactory. The author has developed an interstitial condenser for measuring relatively low dosages. This condenser is small, and in order to avoid steep variations in dosage near the radium, it must not be asymmetrical. The dose rate must be from 30 to 50 r/hour, in 5 to 10 day treatments. The exposure time is 1 minute. The condenser may be sterilized for use in the operating room by enclosure in a dry sheath.

Since condensers cannot be boiled or immersed in antiseptic solutions, a trocar type of cannula has been devised for this purpose. The cannula may be inserted into the tumor and the condenser inserted into it for measuring purposes, which is done in terms of volts. Sensitivity in volts lost per roentgen varies with the type of condenser used.

Several cases are presented in which the dosage has been calibrated by two-plane x-ray films and condenser units. The results convince the author of its value, especially in those instances in which it is impossible to take two-plane films.

The use of nonuniform loading radon needles is advocated in those cases in which the tumor volume creates technical difficulties. By so doing, the uniform dose of a needle may be raised from 60 to 85 per cent, and even to 92 per cent of the active length of the needle. A Geiger-Muller counter can also be used as a dosimeter in the measurement of interstitial radium implantation.

A serviceable lethal tumor dose for epitheliomas is estimated at 6,000 r. delivered in from 7 to 10 days. Tongue, skin, and breast lesions can tolerate 5,500 to 7,000 r.

An effective tumor dose is dependent on the cellular activity of repair and proliferation, and radio

resistance. Maintenance of viable connective tissue is just as important as the deliverance of a tumor dose.

The authors state that with the use of the volume dosage system, as devised by Patterson, one could estimate a tumor dose for any given volume of tumor.

MAURICE D. SACHS, M.D.

## MISCELLANEOUS

Koller, P. C., and Smithers, D. W.: Cytological Analysis of the Response of Malignant Tumors to Irradiation as an Approach to a Biological Basis for Dosage in Radiotherapy. *Brit. J. Radiol.* 1946, 19: 89.

The authors tried to determine the optimal tumor dose and the optimal mode of fractionation in the irradiation treatment of neoplasms.

This attempt is based on the assumption that the response of the tumor to irradiation depends upon at least two different reactions: an intracellular and an intercellular one. The former occurs prior to the latter. The treatments have to be phased according to their cycle. Furthermore, the intensity of the irradiation and the amount of irradiation has to be selected so as not to suppress the second reaction too much while the first one is to be produced; and, vice versa, the first one must not be too weak and therefore allow the second reaction to stimulate a tumor-protective process in the tumor bed.

This assumption has now been better supported by the cytological experiments of one of the authors, as well as by irradiation of tumors in animals and patients followed up by a great number of biopsies by the other author.

It was found that the optimal tumor dose varies not only with the type of tumor but also with different tumors of the same histological appearance. The fractionation and termination of the treatments was guided by repeated biopsies, except in the case of deep seated tumors which did not lend themselves to frequent biopsies.

The authors draw the following conclusions:

1. Fractionated treatment is superior to single dose treatment, (a) because a greater number of cells can be affected in a sensitive phase (intracellular reaction), and (b) because the second phase of the irradiation reaction may be controlled (intercellular reaction).

2. Routine fractionation consisting of equal daily doses should be abandoned in favor of individually graduated time dosage distribution guided by cytological control of the tumor while the treatment proceeds.

GERHART S. SCHWARZ, M.D.

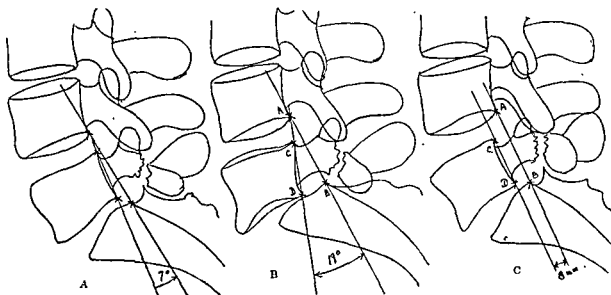


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MATRICE D. SACHS, M.D.

## RADIUM

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With the advent of radium as a therapeutic agent, several problems were immediately presented:

1. With the use of glass radon seeds, necrosis was found in the immediate area. (It was obvious that a better quality ray was needed.)

2. With the help of physicists, it was found that a more even distribution of radiation could be brought about by placement of needles of tubes around the periphery of the tumor, or, interstitially, approximately 1 cm. apart.

3. More accurate knowledge was found to be needed of tumor types and sites, and their response to radiation, in order to judge better the amount to be given.

In addition, the following problems must be considered and solved:

1. Difficulty of radium accessibility to tumor.
2. Tumors friable, so that needles move in tumor.
3. If inserted into a taut lesion, radium needles' position variable with the release of tension on lesion.
4. Correlation of kind of radium implants with the type of tumor.
5. Radium position dependent on movement of patient.

In order to control these sources of error, x-ray films should be taken in at least two planes with radium in position; also, a better method of radium implantation and a better method of estimating necessary tumor dosages are required.

An alternate method of demonstrating radium implantation in estimating tumor dosage may be used by taking two exposures on one film and shifting the tube for the second exposure.

Physicist and radiation therapist should work together in close harmony in order to achieve greater accuracy in the implantation of radium. All available methods which will be of aid to the physician should be used.

The therapeutic efficacy of radium and x-ray therapy in neoplasms is dependent on a minimal lethal tumor dose over a correct period of time. Planned treatments should call for a minimal, maximum, and general average tumor dose.

The difficulties of radium implantation are discussed. Inasmuch as it is difficult to insert radium needles parallel to each other, especially if the tumor contour is irregular, many devices have been tried; however, none has been entirely satisfactory. The author has developed an interstitial condenser for measuring relatively low dosages. This condenser is small, and in order to avoid steep variations in dosage near the radium, it must not be asymmetrical. The dose rate must be from 30 to 50 r/hour, in 5 to 10 day treatments. The exposure time is 1 minute. The condenser may be sterilized for use in the operating room by enclosure in a dry sheath.

Since condensers cannot be boiled or immersed in antiseptic solutions, a trocar type of cannula has been devised for this purpose. The cannula may be inserted into the tumor and the condenser inserted into it for measuring purposes, which is done in terms of volts. Sensitivity in volts lost per roentgen varies with the type of condenser used.

Several cases are presented in which the dosage has been calibrated by two-plane x-ray films and condenser units. The results convince the author of its value, especially in those instances in which it is impossible to take two-plane films.

The use of nonuniform loading radon needles is advocated in those cases in which the tumor volume creates technical difficulties. By so doing, the uniform dose of a needle may be raised from 60 to 85 per cent, and even to 92 per cent of the active length of the needle. A Geiger-Müller counter can also be used as a dosimeter in the measurement of interstitial radium implantation.

A serviceable lethal tumor dose for epitheliomas is estimated at 6,000 r. delivered in from 7 to 10 days. Tongue, skin, and breast lesions can tolerate 5,500 to 7,000 r.

An effective tumor dose is dependent on the cellular activity of repair and proliferation, and radio

resistance. Maintenance of viable connective tissue is just as important as the deliverance of a tumor dose.

The authors state that with the use of the volume dosage system, as devised by Patterson, one could estimate a tumor dose for any given volume of tumor.

MAURICE D. SACIS, M.D.

## MISCELLANEOUS

Koller, P. C., and Smithers, D. W.: Cytological Analysis of the Response of Malignant Tumors to Irradiation as an Approach to a Biological Basis for Dosage in Radiotherapy. *Brit. J. Radiol.* 1946, 19: 89.

The authors tried to determine the optimal tumor dose and the optimal mode of fractionation in the irradiation treatment of neoplasms.

This attempt is based on the assumption that the response of the tumor to irradiation depends upon at least two different reactions: an intracellular and an intercellular one. The former occurs prior to the latter. The treatments have to be phased according to their cycle. Furthermore, the intensity of the irradiation and the amount of irradiation has to be selected so as not to suppress the second reaction too much while the first one is to be produced; and, vice versa, the first one must not be too weak and therefore allow the second reaction to stimulate a tumor-protective process in the tumor bed.

This assumption has now been better supported by the cytological experiments of one of the authors, as well as by irradiation of tumors in animals and patients followed up by a great number of biopsies by the other author.

It was found that the optimal tumor dose varies not only with the type of tumor but also with different tumors of the same histological appearance. The fractionation and termination of the treatments was guided by repeated biopsies, except in the case of deep seated tumors which did not lend themselves to frequent biopsies.

The authors draw the following conclusions:

1. Fractionated treatment is superior to single dose treatment, (a) because a greater number of cells can be affected in a sensitive phase (intracellular reaction), and (b) because the second phase of the irradiation reaction may be controlled (intercellular reaction).

2. Routine fractionation consisting of equal daily doses should be abandoned in favor of individually graduated time dosage distribution guided by cytological control of the tumor while the treatment proceeds.

GERHART S. SCHWARZ, M.D.

## MISCELLANEOUS

### CLINICAL ENTITIES—GENERAL PHYSIOLOGICAL CONDITIONS

Corey, E. L.: Medical Aspects of Blast. *U. S. Nav. M. Bull.*, 1946, 46: 623.

The term "blast" has been used to identify the intense sound wave emanating from a detonated explosive. As a result of poor usage of the term, it is now used to describe true air blast, underwater concussion, transmitted impact through hulls, ground shock, and the after vibration of walls and other structures. The author suggests that the term "explosion pressure" would be more precise, thus enabling one to refer to "explosion pressure in air" or "explosion pressure in water" while using the terms "ground shock," impact transmission through solids, and similar terms wherever they may convey the most precise meaning.

Blast may be defined as the compression (and in air, the suction) wave which is set up by the detonation of an explosive. A blast wave in air is composed of a pressure, followed by a suction component, the latter being of much longer duration than the compression phase (approximately 0.0006 and 0.03 seconds, respectively). The positive phase may exert pressures measured in hundreds of pounds per square inch (close to the charge), whereas the negative pressure can never exceed 15 pounds per square inch because it corresponds to a perfect vacuum. The velocity and duration of either phase are such that the body of a man would be completely immersed for an instant in a wave of almost uniformly altered pressure.

A blast wave is, physically, simply a very intense sound wave. Thus, although the velocity with which the blast travels close to a charge varies with the "power" of the explosive (volume of gas produced multiplied by heat generated), it is quickly reduced to the speed of sound, and decreases in pressure as the square of the distance. This is true of blast waves generated in either air or water, and indeed of the rate of transmission of a blast wave through any material, including the human body.

Since a blast wave is essentially an intense sound wave, its velocity varies with temperature. About 1,100 feet per second may be taken as an average figure, in air; in water its velocity approximates 4,800 feet per second, and peak pressures generated are much more severe than in air. As the human body is about 75 per cent water, the blast wave will traverse the tissues at over 4,000 feet per second. As in air, the "shock front" or compression wave is of sufficient thickness to impose uniformly elevated pressures on all parts of the body of swimmers or divers simultaneously.

Blast pressure is profoundly affected by the nature of the terrain. Thus, its intensity is greatly diminished within depressions such as foxholes, trenches

and ditches, and directly behind trees, bunkers, and walls. On the other hand, the blast wave is reflected from vertical surfaces, theoretically increasing the peak pressure by 100 per cent. Actually, the pressure caused by "reflectance" falls slightly short of this figure. Reflectance from the ground, cliffs, and walls of buildings, together with that under water, from the shoreline, hulls of vessels, and from docks and pilings, may produce many almost unpredictable variations in pressure. In water, temperature gradients between the surface and the bottom distort the "shock front" and cause it to curve toward the colder strata. Hence, with a surface temperature above that at the bottom of even shallow water, the shock front is very perceptibly "bent" toward the bottom, rather than travelling in a straight and horizontal direction. When these variables are introduced, the freakish and almost unpredictable results of a blast may be understood.

The single type of lesion uniformly present in air blast is "bruising and rupture of the lungs." Pulmonary damage may be either slight or severe, its extent depending upon the magnitude of the blast pressure. Thus lesions may vary from small punctate areas to massive hemorrhage with hemothorax. The cause of this type of injury is the positive phase of the blast, although similar lesions may be caused by explosive decompression. Yet, experience with explosive decompression in man (aviation medicine) indicates that decompression in air, even at rapid rates, is relatively harmless. Although the pulmonary lesions are those most commonly encountered, there is no doubt that sufficiently elevated pressures may produce rupture of the gastrointestinal tract. That air blast per se is ineffective at any considerable distance from even large charges has been effectively shown in animal experiments and from a study of the casualties resulting from the blast which occurred at the Naval Air Station, Norfolk, Virginia, in September, 1943, when several Torpex charges were accidentally detonated. After a careful study of the 55 casualties from this explosion, it was concluded that (1) "blast injury" is probably not a major factor in producing injuries from large bomb explosions, inasmuch as no recognizable cases of "blast lung" were observed following the Norfolk disaster, and (2) such explosions produce terribly mutilating injuries from missiles as well as burns ranging from first to third degree.

During World War II, underwater blast has been a far greater producer of casualties than has blast in air. This is due to the greater intensity of an underwater concussion for a given weight of charge. The pathology found in these cases has been described by Greaves *et al*, and may be considered typical of this type of injury in all details. In cases of severe injury, the lungs are characterized by diffuse hemorrhage throughout the entire parenchyma, very little

istered systemically to control impending or established invasive infection<sup>1</sup>

The ability to check invasive infection by chemotherapy freed the surgeon from inhibitions that long have stayed his hand. The fear of fanning the fires of infection by the surgical manipulation of infected tissues following trauma was banished. A bold revolution in the management of wounds took place. This has led to changes in the basic concept of the surgical approach to wounds and traumatic injuries.

#### REPARATIVE SURGERY

By the acceptance of the term "reparative surgery" in a War Department Technical Bulletin (TB MED 147, March, 1945), the Surgical Consultants Division of the Office of The Surgeon General gave official recognition to a concept of wound management that originated in the Mediterranean Theater of Operations. The validity of the concept was strengthened by subsequent experience in the field. The cessation of combat in northern Italy found it firmly established among the surgeons of the Theater.

This phase of wound surgery follows the 'débridement' or initial wound surgery established as a basic procedure in World War I and perpetuated in the recent war as the key stone of wound management. Reparative surgery has been described as follows: "A highly significant and far reaching advance in military surgery has taken place in the base hospitals with the development of what may be called reparative surgery. Wounds left unsutured at the initial operation are routinely closed by suture usually at the time of the first dressing. With the use of penicillin as a safeguard against infection, the management of wounds complicated by fracture or joint involvement has been revolutionized. Surgical procedures in special fields of surgery—thoracic,

cranio-cerebral, abdominal—have also been radically altered by the application of similar principles. The significance of this development and its effect on returning an increased number of wounded soldiers to duty and in preventing deformity, disability, and death in the seriously wounded can hardly be overestimated.

"Reparative surgery is not to be confused with the reconstructive surgery of the Zone of the Interior. Reparative surgery is designed to prevent or cut short wound infection either before it is established or at the period of its inception. Once established wound infection is destructive of tissue and at times of life. In many instances it permanently precludes the restoration of function by the most skillful reconstructive efforts.

"If the initial wound operation has been a complete one, wounds of the soft parts may be closed by suture on or after the fourth day. The dressing applied in the evacuation hospital is removed under aseptic precautions in an operating room of a general hospital at the base. Following closure, the part is immobilized preferably by a light plaster encasement, or if this is impractical, by bed rest" (5).

A parallel evolution in wound management, differing only in unimportant details, took place in the Central Mediterranean Forces of our allies, with whom a close and cordial professional relationship was enjoyed from the time of the invasion of North Africa. Brigadier Harold C. Edwards (9) Consulting Surgeon A.F.H.Q. in a Report to the Director of Medical Services covering the period March 1 to October 31, 1944 referred to the subject as follows: "It is not too much to claim that the surgery of war wounds has undergone a radical change since the first mass experiment in delayed suture was planned before the battle of Cassino.

*'The accepted treatment of all wounds as a two stage operation'* irrespective of whether an open fracture exists or not. This conception has led to an immense diminution in invalidism as a result of chronic sepsis of pain and discomfort, and of numbers of dressings. It has led to an incalculable saving of hospital beds (one analysis has showed the saving to be

Italics by the writer

<sup>1</sup>That deep instinct of the surgeon to anoint the wound with healing balms, salves or antiseptics and to keep it open with setons, tents or tubes, finds its roots in the mysticism and polypharmacy of the ancients. It still plagues our craft in the usage of the precise tools of chemotherapy and antibiotic agents. A long line of illustrious surgeons, basing their experience more often than not on the battlefield, have combatted the doctrine that the healing of a wound is governed by the topical applications of the surgeon. This line of dissenters extends from Lord Mowbray, the great sceptic of World War I, through Lister, Wurtz, Paré, Henry of Menderville, Hugh of Lucca and Theoderic, Celsus, and the Good Samaritan, to Hippocrates.

## SURGERY GYNECOLOGY AND OBSTETRICS

as 24-35) and in consequence of manpower Men are fighting now<sup>1</sup> who have already twice recovered from wounds since the 'D Day for Cassino—May 12th. Furthermore the resulting scars have been firmer less adherent and less liable to break down.

In the Royal Army Medical Corps the terms delayed suture and secondary suture were retained and the program as a whole referred to as the treatment of a wound by a two-stage operation.

The adjective *reparative* was chosen by the U S Army Medical Corps to set apart the phase of surgery under discussion from the initial operation (débridement) that precedes it and the reconstructive surgery that may follow. Reparative surgery has been referred to as surgery of necessity for a limited time exists following the initial surgery during which its maximum benefits may be secured. It is neither emergency surgery on the one hand, nor elective surgery in the sense that it may be postponed, on the other. The word *reparative* was chosen with reference to the technical procedures that repair damaged and distorted anatomic parts also it indicates that the surgery coincides with the period of greatest biologic activity in wound repair. This starts on the fourth day the time selected on purely clinical grounds as the optimal time for surgical repair of a soft tissue wound. There is no sharp end point, but for the simple wound the optimal phase for surgery closes at approximately the tenth day. This time interval for reparative surgery is fixed by biologic laws to which military planning must accede unless grim necessity demands sacrifice of that part of the potential combat strength of the force evacuated as lightly wounded.

The application of the procedures of reparative surgery requires an analysis of a wound in terms of the structures that have been damaged for the repair of each tissue and structure is subject to different laws. It also stimulates a precise analysis and recast of terminology to achieve uniformity in definition and clarity in thinking.

It is important that the scope of the term *reparative surgery* be clearly understood. It is by no means synonymous with *delayed*

primary suture, delayed suture, and secondary suture." Reparative surgery defines a phase of wound management during these procedures, referred to as the second stage of the two-stage operation by Edwards, are carried out. In addition, other operations such as decortication of the lung, the early removal of foreign bodies, the repair of nerve injuries, and the final reduction of battle fractures are considered as reparative surgery because they are designed to prevent or cure short wound infection either before it is established or at the period of its inception or concerned with restoration of the function of the part by anatomic repair.

Wounds are referred to as *simple*<sup>2</sup> or *soft tissue* wounds when the injury is confined to skin, subcutaneous tissue and fascia, and muscle damage is not extensive. A *complex*<sup>3</sup> wound has, in addition to the soft tissue wound, damage to nerve, bone, tendon, joint or major vascular trunk, or extensive damage to muscle that will materially interfere with function. In the management of a complex wound subsequent to the initial surgical débridement, separate consideration must be accorded each component part of the wound, such as the wound of the soft tissue, the wound of the bone or that of the nerve. The timing the sequence and the extent of the reparative surgical procedures carried out on a complex wound are determined by its component parts, their extent and nature, and the wide variety of combinations in which they may be present.

Thus the term *reparative surgery* designates a phase of wound surgery applicable to complex wounds as well as simple wounds.

<sup>1</sup>The term *simple gunshot wound* was defined and used by G. J. Guthrie in recording the opinions and practice of the Medical Department of the British Army at the termination of the Wars in Spain, Portugal, France, and the Netherlands, in this and Army. Simple wounds were "Wounds in Parts of the Body in which the Portals of the Consequence is the Human Frame." Various terms have been used to describe wounds that are more extensive than simple wounds. The adjective *compound*, is closely linked by usage with open injuries of bone and joint and has thereby acquired specialized significance. The term *fractured* implies complications such as secondary hemorrhage or infection and for this reason is best reserved for wounds with sequential pathologic entities. Also, *specialized* means has developed to bone and joint surgery and *complicated* injury is one with adjacent injury to other structures such as nerve or joint. In the sense used here, *complex wound* is one with multiple and important anatomic components that are interrelated. It contrasts neatly with the simple wound of the military surgeon of the past.

<sup>2</sup>The report is dated 6 December 1944.

rather than any single technical procedure such as delayed suture of the soft tissues. It includes a wide variety of operative procedures for complex wounds as well as closure of the skin and underlying soft tissue. Also as a comprehensive term it includes a number of methods of closure of simple wounds that find a constant application when large numbers of casualties are being treated. The terms 'delayed primary suture' and 'secondary suture' describe the closure of the skin in terms of the time interval that has elapsed before closure is attempted. Universal agreement is lacking as to the actual time intervals that are implied by the use of these two terms and experience has shown that, after all, no sharp line exists so far as the ultimate result is concerned provided the surgical technique employed is adapted to the specific problem at hand. For this reason the inclusive term 'reparative suture' has come into use implying a delay and contrasting with primary suture.

In general the following principles will be found valid in the management of a simple wound or the soft tissue component of a complex wound.

1. When the initial surgery (débridement) has been complete and the wound has been protected from subsequent contamination by an occlusive dressing and adequate splinting the optimal time for closure is the fourth post-operative day. At this time muscles and fascial planes may be sutured with catgut, cotton or silk, and closure of the skin defect may be aided by the advancement or rotation of flaps or the application of a split thickness graft.

2. As the time interval is increased beyond the fourth day, the feasibility of anatomic layer closure diminishes and there is a steadily increasing number of cases in which closure must be performed by single sutures passing through all layers.

3. On or about the tenth day it will be found necessary to undercut the cutaneous margins, with or without the removal of surface granulation tissue to obtain skin approximation. The incidence of kindly healing will be appreciably lessened and the ultimate scar will tend to spread.

4. Again as the time interval is extended beyond the fourth day there will be found an

increasing indication completely to excise the wound before suture thus to restore flexibility and permit layer closure. This procedure is limited to wounds in anatomic regions where additional loss of tissue will not interfere with the ultimate functional or esthetic result. In very late wounds (3 weeks to 6 months) complete wound excision is an essential prelude to closure by suture and may be necessary or advisable preceding skin grafting.

5. When the initial surgery (débridement) has not been complete and devitalized tissue remains in the wound a purulent exudate at times associated with a foul odor will be apparent by the fourth day. Under these circumstances the residual necrotic tissue may be excised and the wound closed immediately or following excision the wound again may be left open and closure undertaken when it is certain that all dead tissue has been removed and invasive infection is not to be reckoned with.

6. When invasive infection is present, free drainage is established and tissue devitalized by the infection or by the original trauma is excised. The interval before closure may be attempted varies with the severity and extent of the infection but usually falls within the 10 day period following the operation.

Management of the soft tissue component of a complex wound is modified by the treatment that must be directed to those injured structures that are important to the ultimate function of the part. In a complex wound the goal of reparative surgery is not limited to the closure of the soft tissues and skin but extends to the repair of the wound of the bone, the nerve or the important muscles that have been divided. In general early closure of the skin is greatly desired to exclude further bacterial contamination but it may be delayed deliberately. For example following reparative suture of a transversely divided quadriceps femoris or deltoid muscle the skin may be left unsutured in selected cases to provide free escape for blood and wound exudate. Skin closure is then carried out in approximately 4 days. Battle fractures are complex wounds and usually the most important component of the wound is the fracture rather than the soft tissue defect. After accurate re



duction is secured closure of the muscles over the fracture site is the most vital step of reparative surgery. Suture of the skin may be delayed, or if the defect is small, spontaneous healing may be anticipated long before the fracture is united. Again complete or partial division of a nerve may be the most important component of a wound. Here the first step may be complete suture of the soft tissues and skin to obtain clean healing with minimal scar formation. Repair of the nerve then may be undertaken at a 3 week interval. When nerve and bone are both injured still more elaborately staged procedures may be indicated, always with the goal of the restoration of the ultimate function of the extremity in mind.

The surgical principle that has emerged may be summarized as follows. Following an open traumatic injury excision of dead and devitalized tissues should be done at the earliest opportunity. This may be considered as an initial operation and care is taken to conserve all viable parts that are important to subsequent function. Dressings and splinting are designed to minimize swelling and prevent further damage to structures by motion. Invasive infection is held in check by systemic chemotherapy. The patient may then be transported to receive the full benefit of whatever specialized technical skills are required for the reparative surgery of complex injuries. The application of this principle in civilian trauma is readily apparent.

#### THE PATTERN OF TRAUMA

The war experience with traumatic injury emphasizes the need for further understanding of what may be called the pattern of trauma. When individuals are simultaneously subjected to trauma or sequentially exposed to the same trauma, the resulting injuries conform to a type pattern. This has long been recognized in civilian injuries, and entities such as miners' elbow and bumper fracture are surgical classics. It is a familiar finding in disasters and I need only mention the Cleveland Clinic fire and the Boston Coconut Grove fire to emphasize the necessity for immediate recognition of the pattern of trauma. There were similar incidents during the war such as the Bari air raid and of course most

notably the atomic bomb attacks on Hiroshima and Nagasaki. Recognition of the pattern of trauma must be prompt in disaster to point the way toward effective treatment of the survivors. A recurring pattern in injuries sustained sequentially under similar circumstances leads the surgeon to propose preventive measures.

#### PREVENTIVE SURGERY

World War II witnessed a rudimentary but clear appreciation of preventive surgery as an undeveloped phase of our craft. Preliminary explorations were made in the use of protective armor against flying missiles. Protective body armor in the form of a "flak suit" was adopted early by the Air Force. Careful analyses on the lethality of weapons and the distribution of wounds document the assertion by DeBakey (8) that the application of existing knowledge on body armor might "reasonably be expected to reduce the number of those killed in action by 12 per cent and of those wounded in action by 8 per cent. Although the war ended before body armor could be used in any area of land combat, other protective devices, in addition to the familiar steel helmet, were introduced by surgeons. Sir Alexander Hood (11) points out that the familiar crash helmet of the British Army was designed by a neurosurgeon (Hugh Cairns). Surgeons of the European Theater of Operations (7) assisted the medical service of the Air Force in a vigorous effort to prevent high altitude frostbite. With protective equipment and procedures this crippling injury of expert bomber crews was virtually eliminated. Ophthalmologists conducted extensive field studies on the use of shields designed to protect the eyes from the hazards of land mine and booby trap explosions.

The control and prevention of blast injuries of the ears were effected by joint study of Ordnance and the National Research Council. The incidence of aero-otitis, a common disability that grounded highly trained air crews was greatly reduced by control measures. Footgear effective in the prevention of trench foot was developed through Medical Department liaison with the Quartermaster. Tetanus, an ancient scourge of the battlefield, was vir-



Members of the Council of National Defense and the Advisory Commission Seated, left to right David F. Houston, Josephus Daniels, Newton D. Baker, Chairman of the Council, Franklin K. Lane, William B. Wilson. Standing

left to right Grosvenor B. Clarkson (Secretary), Julius Rosenwald, Bernard M. Baruch, Daniel Willard, Dr. Franklin H. Martin, Hollis Godfrey, Howard E. Coffin, Walter S. Gifford (Director).

tually eliminated by the inoculation with toxoid.

It is clear that this preventive phase of surgery must be developed with vigor and imagination to keep pace with the traumatic hazards of modern life or surgery will remain solely a salvage service. Although the surgeon is historically the senior practitioner of the battlefield, his place of importance has been yielded to the expert in preventive medicine in the conflict of mass armies. With the awful increase in the lethality of weapons and the destruction of the civilian population as the strategic objective of the enemy, it seems unlikely that military surgery will ever regain its ancient position by virtue of its salvage func-

tion alone. As the military power of this country depends upon highly specialized personnel operating extremely complicated weapons and machines, the military surgeon of the future must be an expert in the prevention of traumatic injury in addition to its alleviation.

#### THE DOCTOR AT WAR

Having discussed certain ways in which his war experience may have modified surgical theory and concept, I shall deal briefly with broader phases of the experience of the American Surgeon A. U. S. Pearl Harbor found the civilian medical profession in a maze of poorly integrated but highly developed specialism in remedial medicine. The prevailing tactical



There were many lessons of the first World War that were promptly forgotten or the significance of which at the time were really not appreciated. In looking back at the experience of World War I with the perspective of the recent war there is no single item that has more profound significance than the position occupied by Franklin H. Martin as the representative of the medical profession during the first conflict. It contrasts with the lack of a medical statesman at that level in World War II. On October 11, 1916, President Woodrow Wilson appointed Franklin H. Martin to the Advisory Commission of The Council Of National Defense. The story is graphically told by the pen of Dr. Martin (17) himself in his *Digest of the Proceedings of the Council of National Defense during the World War*. Representation of the profession in an advisory capacity at the Cabinet level insured that the voice of Medicine could be heard.

In this respect I would be remiss not to pay sincere and deserved tribute to our own Dr. Fred W. Rankin. Without the strategic advantage of position granted to Dr. Martin in World War I it was inevitable that General Rankin's well designed efforts should meet with frustration time and time again. Nevertheless, by skillful and untiring efforts as Chief Surgical Consultant he stands out as the Sponsor of the American Surgeon A U S and the corner

stone upon which the achievements of American Surgery in World War II were erected.

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TABLE I—COMPARISON OF THE INCIDENCE OF THE CAUSES OF DEATH IN PENETRATING WOUNDS OF THE ABDOMEN BEFORE AND AFTER CHEMOTHERAPY

1 cases admitted between January 1938 and January 1942			6 cases admitted between January 1942 and May 1946		
Per cent			Per cent		
Mortality rate			Mortality rate		
27.9			11.6		
Causes of death	Cases no.	Per cent	Causes of death	Cases no.	Per cent
Peritonitis	9	31.0	Hemorrhage	7	30.4
Hemorrhage	7	24.1	Pneumonia	4	17.4
Shock	6	21.3	Putrefactive empyema	4	17.4
Pneumonia	5	17.3	Peritonitis	3	8.7
Uremia	1	3.4	Meningitis	3	8.7
Retroperitoneal cellulitis	1	3.4	Uremia	1	4.3
			Undetermined	1	4.3

death in only 2 instances in the patients treated with sulfonamides. There is also evidence that systemic sulfadiazine therapy has had a similar beneficial effect in operations for resection of the bowel by greatly reducing the incidence of postoperative peritonitis

#### THERAPEUSIS

The value of sulfonamide therapy has been unquestionably established in acute infections produced by a hemolytic streptococcus the pneumococcus and the gonococcus but it is of little or no value in those caused by the hemolytic staphylococcus (2, 4, 12, 13, 18). Its advantages of low cost, ease of administration and high bacteriostatic action often make it the drug of choice in these infections.

Sulfadiazine is still a valuable drug in certain mixed infections produced by various gram negative and gram positive bacteria of the intestinal tract. *In vitro* studies on examples of mixed bacterial flora show that its marked bacteriostatic action is usually superior to that of penicillin in the usual concentrations which are built up in the blood during systemic therapy (Fig. 1). Clinical experience has likewise demonstrated the effectiveness of this form of chemotherapy in mixed infections. More recently very large doses of penicillin have proved to be very effective in the management of mixed infections. However certain limitations of sulfonamide therapy have become increasingly apparent including (1) the presence of bacterial species and group resistance (2) the inactivation of bacterio-

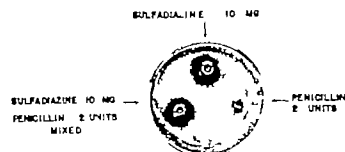


Fig. 1. Blood agar plate showing the superior bacteriostatic effect *in vitro* of sulfadiazine over that of penicillin on a mixed culture of both gram negative and gram positive bacteria. *Pseudomonas aeruginosa*, *Staphylococcus aureus*, resistant to penicillin. *Escherichia coli*, *Streptococcus viridans*, resistant to penicillin. Hemolytic streptococcus, susceptible to penicillin. *Staphylococcus aureus*, susceptible to penicillin. Nonhemolytic streptococcus, resistant to penicillin.

static activity by inhibitors found in pus wound exudates and necrotic tissue (3) the development of drug fastness by many of the infecting bacteria (4) the occurrence of some toxic reactions when its administration was not carefully controlled (5) its inability to penetrate areas of pus and necrosis and (6) the occasional occurrence of drug idiosyncrasy.

With the introduction of penicillin many of these limitations have been overcome. The sulfonamide inhibitors have little or no effect on the bacteriostatic action of penicillin and its extremely low toxicity has been of equal significance. Doses of one million units every 3 hours have been used repeatedly and in one instance a child received 100,000,000 units each 24 hours for 2 weeks without evidence of toxicity (13). The toxic reactions that have occurred during penicillin therapy have been due largely to impurities or idiosyncrasies and the threshold of toxicity as yet is undetermined.

At the present time penicillin is the most effective chemotherapeutic agent available for the treatment of many surgical infections particularly those caused by the staphylococci, the aerobic streptococci, the gonococci and the anaerobic streptococci. Evidence of its superiority over the various sulfonamides in the therapy of staphylococcal infections is overwhelming and its effectiveness in infections caused by sulfonamide-resistant strains of the streptococcus and gonococcus have been outstanding. The micro-organisms sensitive to its action *in vitro* are listed in Table II and

TABLE II.—PENICILLIN ACTIVITY IN VITRO—  
SENSITIVE MICRO-ORGANISMS

<i>Gonococcus</i>	<i>Clostridium histolyticus</i>
<i>Mercuricoccus</i>	<i>Clostridium septicum</i>
<i>Streptococcus</i>	<i>Clostridium sordelli</i>
hemolytic	<i>Clostridium oedematis</i>
viridans	<i>Clostridium sporogenes</i>
microaerophilic	<i>Clostridium fermentans</i>
anaerobic	<i>Bacillus diphtheriae</i>
<i>Staphylococcus</i>	<i>Bacillus pseudodiphtheriae</i>
aureus	<i>Lactobacillus</i>
albus	<i>Cryptococcus hominis</i>
anaerobic	<i>Spirillum minus</i>
<i>Micrococc</i>	<i>Streptobacillus moniliformis</i>
<i>Pneumococcus</i>	<i>Treponema pallidum</i>
<i>Bacillus subtilis</i>	<i>Bacillus alkaligenes</i> (some strains)
<i>Bacillus anthracis</i>	<i>Leptospira interrogans</i>
<i>Actinomyces bovis</i>	<i>Erysipelothrix rhusiopathiae</i>
<i>Clostridium tetani</i>	
<i>Clostridium tetanomorphum</i>	
<i>Clostridium botulinum</i>	
<i>Clostridium welchii</i>	

those resistant in Table III. More recently the very low toxicity of penicillin has permitted exploration of the clinical value of very large doses in infections produced by bacteria resistant or slightly susceptible to its action. The encouraging results obtained justify a more thorough investigation of the therapeutic possibilities of large doses up to one million or more units every 3 hours in this type of infection.

In the 4 years between November 1942 and November 1946 704 surgical infections treated with penicillin surgery when indicated and the general and local supportive measures for correction of altered physiology have been studied and they included the following:

Staphylococcal infections	47
Pneumococcal infections	70
Anaerobic streptococcal infections	
Aerobic streptococcal infections	80
Gonococcal infections	40
Actinomycotic infections	7
Human bit infections	9
Ratbite fever infections	8
Gas gangrene infections	
Pyoderma gangrenosum infections	4

Experience has shown that penicillin is the chemotherapeutic agent of choice in the treatment of all staphylococcal infections in surgery having replaced all previous forms of chemotherapy. An arbitrary tabulation of the clinical results obtained with penicillin in the treatment of the 427 cases with established staphylococcal infections is given in Table IV.

TABLE III.—PENICILLIN ACTIVITY IN VITRO  
RESISTANT OR SLIGHTLY SUSCEPTIBLE  
STRAINS OF MICRO-ORGANISMS

<i>Bacillus coli</i>	<i>Acne bacillus</i>
<i>H. influenzae</i>	<i>M. tuberculosis</i>
<i>Bacillus typhosus</i>	<i>Bacillus thuringiensis</i>
<i>Bacillus paratyphosus</i>	<i>Brucella melitensis</i>
<i>Bacillus dysenteriae</i>	<i>Brucella abortus</i>
<i>Bacillus proteus</i>	<i>Bacillus anthracis</i>
<i>Bacillus enteritidis</i>	<i>Moraxella mallei</i>
<i>Bacillus pyocyaneus</i>	<i>Moraxella mallei</i>
<i>Aerobacter aerogenes</i>	<i>Blastomycetes</i>
<i>Bacillus fluorescens</i>	<i>Torulispora</i>
<i>Bacillus friedlanderi</i>	<i>Bacillus mycoides</i>
<i>Bacillus prodigiosus</i>	<i>Lymphophilus crenatus</i>
<i>Bacillus pastis</i>	
<i>Vibrio cholerae</i>	

The effects of penicillin therapy were particularly apparent in the treatment of the severe staphylococcal infections with invasive manifestations. If the infection was in the diffuse or cellulitic stage, penicillin therapy was often followed by complete and spontaneous resolution and a minimal amount of local destruction of tissue (Fig 1). If the diagnosis

TABLE IV.—RESULTS IN PENICILLIN THERAPY  
STAPHYLOCOCCAL INFECTIONS

Clinical Diagnosis	N cases	Results			
		Excellent	Good	Questionable	Failure
Septicemia	50	11	3		34
Carbuncles	5	11	24		
Cellulitis	40	31	16		
Furunculosis	39	23	4		
Acute hematogenous osteomyelitis	60	25	26		
Chronic osteomyelitis	54	9	11	12	9
Infected wounds	53	31	16		4
Abscess	4	8	6		
Hand infections		6	3		
Abscesses of lung	3	3			6
Brain abscess					
Berthel's	6	8			
Postoperative paronychia	6	4			
Chronic lymphadenitis with lymphadenoma	4		4		
Abdominal cases	4				3
Hydrothorax	9	7			
Pericarditis					
Spinal epidural abscess					





TABLE V — STAPHYLOCOCCAL SEPTICEMIA

	40 Cases treated with sulfonamides, bacteri- ophage, etc. 1940-1943 Per cent	50 Cases treated with penicillin 1943-1946 Per cent
Mortality	67.5	30
Recovery	32.5	70.0
	Hospital days	Hospital days
Fatal Cases	18	21.8
Recovered Cases	80	53.8

The obvious values and limitations of penicillin therapy in the management of this condition are illustrated in a recent study of 90 cases of hemolytic staphylococcus septicemia at the Cincinnati General and neighboring hospitals between 1940 and 1946. A total of 40 cases of staphylococcus septicemia were treated with sulfonamides, surgery when indicated or bacteriophage between 1940 and 1943 and a similar series of 50 cases were treated with penicillin in addition to other medical and surgical medical measures between 1943 and 1946. Table V compares the two series in respect to mortality and morbidity indicating the profound effect penicillin has had upon this infection.

It is apparent that penicillin has approximately reversed the mortality and recovery rates. Whereas only 32.5 per cent recovered under sulfonamide, bacteriophage and other forms of therapy 70 per cent recovered under penicillin therapy. A further analysis of the fatal cases reveals some of the limitations of penicillin therapy (Table VI).

The results in the cases developing vegetative endocarditis particularly early in the series were very poor and this condition accounted for almost half of the deaths. Of the remaining 8 fatal cases, 5 of the deaths occurred within 12 to 48 hours after their admission to the hospital and start of penicillin treatment. In these instances, the fulminating infection or moribund condition of the patient produced death before the maximum chemotherapeutic effect could become manifest. In the case of the infected burn the *Staphylococcus aureus* was resistant to the action of penicillin.

The outcome in the individual case was dependent upon many factors (2, 12) including the age of the patient, the susceptibility of the strain of staphylococcus to penicillin, the site

TABLE VI.—FATAL CASES OF STAPHYLOCOCCAL SEPTICEMIA

Diagnosis	No. of cases
Vegetative endocarditis	1
Pneumonia	1
Infected burn of 60 per cent body surface.	3
Cavernous sinus thrombosis	
Otitis media with lateral sinus thrombosis	
Pericarditis	
Acute osteomyelitis (terminal)	1

and nature of the primary infection, the duration of the bacteremia, the presence and location of secondary or metastatic abscesses, the accessibility of the primary or secondary infections to surgical drainage, and the presence of other associated and complicating diseases. Inadequate treatment predisposed to relapse. Experience has shown that treatment is most successful in young adults or children in whom the diagnosis of staphylococcal bacteremia is made early, penicillin therapy given early and intensively and surgical drainage is possible when indicated.

**Carbuncles.** A carbuncle is essentially a spreading and necrotizing staphylococcal infection of the deeper layers of the skin and subcutaneous tissue which may result in extensive necrosis, sloughing, liquefaction of the subcutaneous tissue, septicemia, and death. The many forms of treatment which have been devised for carbuncles are an indication of our inability to control the locally or generally invasive characteristics of this infection. The great majority of surgeons have learned to employ crucial incisions or excision and because of the tendency of carbuncles to extend locally or invade the general circulation, the treatment of choice at many clinics, including the Cincinnati General Hospital, has been radical excision. Sulfonamide therapy in general has been disappointing due principally to the natural resistance of the hemolytic *Staphylococcus aureus*.

The marked effect of penicillin on the management of carbuncles is shown in a group of 49 cases with carbuncle which we have treated with penicillin between February 1944 and October 1946. 8 of which received both penicillin and sulfadiazine. The dosage employed was 15,000 to 20,000 units every 3 hours given intramuscularly in every instance but one in which it was given intravenously. The average

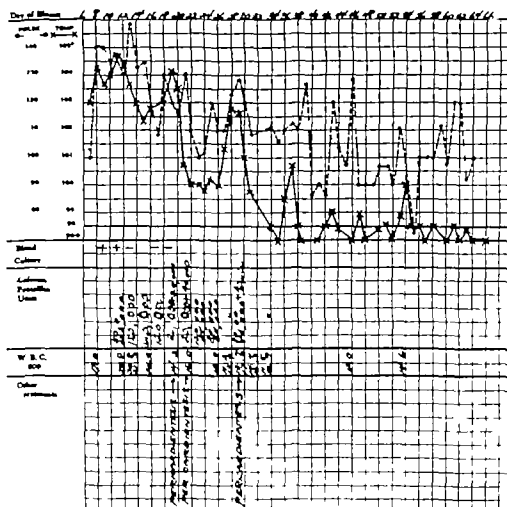


Fig 3 J B aged 8 years acute hematogenous osteomyelitis with bacteremia and metastatic pericarditis. Chart shows failure of response to penicillin therapy until metastatic infectious complication in the form of a pericarditis is recognized and treated as indicated.

total dose was 927 000 units and the average duration was 7 days

The results of treatment indicate that penicillin is obviously the chemotherapeutic agent of choice in this type of infection. When given early in sufficient amounts and over a long enough period of time it brought the general and local invasive manifestations under control within a period of 48 to 72 hours and so modified the subsequent course that both mortality and morbidity were reduced. In our experience penicillin therapy was followed by complete and spontaneous resolution in 26.5 per cent of the cases (Figs. 4 and 5) by partial resolution with centralized necrosis in 22.4 per cent of the cases with partial resolution and abscess formation in 49.0 per cent of the cases, and by failure in 2 per cent of the cases. Thus it was not necessary to subject these patients to emergency total excision of the lesion in

order to control this infection. Since the invasive qualities have been controlled so effectively with penicillin more limited surgical procedures are recommended when indicated consisting of incision and drainage of abscesses occurring during therapy and cruciate incision for the removal of necrotic tissue.

*Acute hematogenous osteomyelitis.* In the past the results of treatment in this condition have been unsatisfactory for several reasons. Difficulties in diagnosis often resulted in delay and spread of the process with extensive destruction of the bone. When early diagnosis

TABLE VII.—RESULTS OF PENICILLIN THERAPY

	Cases	Per cent
1 Spontaneous resolution	13	26.5
2 Partial resolution with necrosis	11	22.4
3 Abscess formation	24	49.0
4 Failure	1	2.0



Fig. 4. F. H. aged 43 years, admitted to Cincinnati General Hospital, August 9, 44, with a large carbuncle of the neck of 3 days duration. Temperature and pulse remained normal after the third day. a, left, Appearance of carbuncle on August 3, 1944. b, start of treatment with penicillin. b, August 12, 1944, disappearance of the carbuncle and almost complete healing have occurred in 9 days.

was made, the principal method of arrest and control of the necrotizing process was emergency decompression of the involved area by surgical drainage followed by prolonged periods of immobilization. More recently chemotherapy with the sulfonamides used as a supplement to surgical intervention aided in the control of the infection but left much to be desired. Penicillin on the other hand has had a profound effect upon acute hematogenous osteomyelitis and has greatly modified both its management (8, 14, 19) and roentgenographic interpretation (9). In the group of 64 cases of acute hematogenous osteomyelitis treated with penicillin the mortality rate was remarkably low being 1.5 per cent. In general the other results of penicillin therapy varied primarily with the time of diagnosis and start of treatment falling into 4 groups.

The first group included those cases in which the correct diagnosis was made within the first 3 or 4 days, and adequate treatment was started immediately. The results were truly excellent surgical intervention usually being unnecessary and abscess formation infrequent. After a period of 36 to 72 hours, the fever, rapid pulse, bacteremia and other general

signs of the severe infection began to disappear. At the end of a week the temperature was usually normal and the patient looked and felt quite well. The local signs of infection, such as tenderness, edema, and redness, also began to recede after a similar latent period. During the next 1 to 6 months a series of roentgenographic changes occurred in the involved bone which were minimal consisting of localized periosteal reaction or small areas of patchy decalcification of the underlying cortex, or both. These findings occasionally were hard to see and could be easily overlooked.

In the second group in which the diagnosis and treatment with penicillin were moderately delayed for 4 to 7 days, the general and local infections were brought under control by penicillin less promptly after a period of 2, 3, or more days during which little or no clinical response was evident. Localized soft tissue abscesses occasionally developed and when small, they were successfully treated by aspiration and local injections of a solution of penicillin. When large surgical drainage by incision was done to minimize further tissue destruction by the accumulated necrotizing bacterial toxins. If surgical drainage was insti-



Fig 5 V L., aged 33 years. a left, Carbuncle of face with diffuse cellulitis, thrombophlebitis of facial external, and anterior jugular veins, staphylococcal bacteriemia, and bilateral pneumonia. Temperature, 106 degrees F at start of penicillin therapy b Effect of 10 days therapy with penicillin.

tuted the fall of temperature was usually prompt and not delayed for 36 or more hours as in the case treated without surgical intervention

After a week or more had elapsed periosteal reaction and localized patchy demineralization of the underlying metaphysis became evident in the roentgenograms and increased in extent and degree becoming most marked 1 to 5 months after the onset of the infection. Recalcification of the demineralized areas followed with re-establishment of a more normal appearance of the bone. Sequestration rarely occurred in this group.

The third group included cases in which the diagnosis and treatment were delayed for 7 to 10 or more days and those in which the infection was unusually severe. The local destruction of bone became very great and soft tissue abscess formation and sequestration occurred in most, but not all of the cases. The local infection was arrested with more difficulty in this type of case and longer periods of treatment with penicillin were usually required. Small abscesses were treated by aspiration and large ones by incision and drainage. Prolonged immobilization by cast in these cases seemed to be definitely indicated.

The bony changes as revealed by serial roentgenograms at the start of penicillin treatment showed extensive bone destruction which increased on subsequent examinations. Se-

questration occurred in most cases and in many instances the smaller sequestra were gradually absorbed spontaneously.

The fourth group included certain fulminating infections in which the patient would not live 48 or more hours to permit the maximum effect of penicillin. Surgical intervention after adequate preoperative preparation was necessary as an emergency measure in addition to intensive penicillin therapy.

In general the effects of penicillin included control of the generalized infection with sterilization of the blood stream, reduction of the mortality rate and decrease in the incidence of metastatic or secondary infectious complications. If metastatic complications such as staphylococcal pneumonia, pleuritis, pericarditis, thrombophlebitis, etc. already existed, penicillin was a powerful chemotherapeutic agent aiding in their control as an adjunct to surgical or conservative treatment as indicated. Thus the morbidity was also decreased.

There seems to be little doubt that adequate penicillin therapy can eliminate the necessity of emergency surgical intervention in most cases of early acute hematogenous osteomyelitis (8, 14, 19). It must be emphasized that early diagnosis can be made only on clinical grounds and that little or no help is to be expected from the roentgenograms for 10 or more days. If there is any doubt as to the presence of an acute osteomyelitis it is better



Fig. 6 M. K. a left, Severe acute hemolytic streptococcal cellulitis of face, neck, and scalp, with gangrene which was resistant to sulfonamide therapy. Temperature was 103 degrees F at start of penicillin therapy. b, Appearance of lesion after control of infection, separation of slough, and preparation of area for skin graft.

to start penicillin therapy rather than wait until the diagnosis is proved.

Of particular interest were the resultant roentgenographic changes which occurred in the involved bone treated with or without surgery. During the period of penicillin therapy evidence of bone damage was absent or confined to minimal changes such as slight periosteal reaction or small areas of demineralization in the underlying cortex. After the cessation of chemotherapy the periosteal reaction and mottled appearance of the underlying bone progressively increased, reaching a maximum 1 to 5 months after the onset of the infection. In this way the bone always looked worse a month or more after penicillin therapy than during it. This picture has been interpreted as being the result of spontaneous absorption of bone destroyed early in the infection and not as the result of continued destruction of bone by an extending chronic osteomyelitic process. Following this recalcification of the involved areas occurred often very rapidly. Meanwhile normal growth of the metaphyses, calcification of the adjacent

epiphyses, and return of function occurred. These facts suggested that adequate penicillin therapy may sterilize the infected bone converting an area of septic necrosis to one of aseptic necrosis. One of the most important aspects of this problem remains unanswered as yet: the question as to whether or not the infection has been completely cured.

**Chronic osteomyelitis.** In chronic osteomyelitis the results were usually disappointing unless penicillin therapy was used in conjunction with radical surgery. Spontaneous resolution of an acute exacerbation was noted in only 9 instances. In the remainder surgery was necessary along with penicillin to clean up the local infective process.

**Acute secondary or postoperative parotitis.** The control of acute secondary parotitis by chemotherapy is desirable since its arrest by conservative measures is uncertain and its control by surgical incision and drainage has certain disadvantages. Incision may result in unsightly scars, occasional injury to the facial nerve, salivary fistulas, or troublesome secondary infection (5). In addition a general anes-

TABLE VIII.—AEROBIC STREPTOCOCCAL INFECTIONS—RESULTS OF PENICILLIN THERAPY

Clinical diagnosis	No. Cases	Results			
		Excellent	Good	Questionable	Failure
Septicemia	26	15	6	1	6
Cellulitis	6	12	4		
Acute hematogenous osteomyelitis	3				
Acute streptococcal gangrene	5	1	2		
Meningitis	4				
Empyema	3		2		1
Pericarditis	2	1			
Peritonitis	2				
Liver abscess	3		1		2
Acute mastoiditis with lateral sinus thrombosis	2	1	1		
Septic abortion	1	0	2	2	

thetic and operation unquestionably throw an added burden upon the patient greatly weakened by some other primary disease which predisposed to the development of the acute parotitis. The simplicity of administration and the directness of action of effective chemotherapy largely obviate these disadvantages. Of 6 patients treated with penicillin 4 underwent complete and spontaneous resolution. A fifth responded satisfactorily to penicillin after failing to respond to Lugol's solution. The sixth underwent partial resolution with the formation of an abscess which was incised.

The general response of this infection to penicillin therapy followed the general pattern seen in other surgical infections treated by chemotherapy. An interval of 24 to 48 hours following the start of treatment preceded the development of obvious signs of clinical improvement. Thereafter the improvement was progressive and usually rapid.

**Aerobic hemolytic streptococcal infections** While most of these infections respond promptly to sulfonamide therapy penicillin is also very effective and particularly valuable in those cases resistant to the sulfonamides (Fig. 6). The results of therapy in cases of hemolytic streptococcal infections treated at this Hospital most of which were sulfonamide resistant, are summarized in Table VIII.

TABLE IX.—ANAEROBIC STREPTOCOCCAL INFECTIONS—RESULTS OF PENICILLIN THERAPY

Clinical diagnosis	No. cases	Results			
		Excellent	Good	Questionable	Failure
Bacteremia	6		1	1	2
Septic abortion	9	2	6		1
Chronic burrowing ulcer	5			3	
Chronic progressive cutaneous gangrene	2				1

In the treatment of anaerobic streptococcal infections, penicillin was far superior to the sulfonamides (3). *In vitro* studies showed its bacteriostatic action under anaerobic conditions for the anaerobic streptococci to be far greater than that of the sulfonamides. We have had an opportunity to use penicillin therapy on 22 cases of anaerobic streptococcal infections and the results are shown in Table IX.

**Pneumococcal infections** The average pneumococcal infections seen in surgical practice respond very well to sulfonamide therapy in much the same manner as do the hemolytic streptococcal infections. Penicillin therapy was therefore reserved for those cases which were sulfonamide resistant and the results obtained in 70 cases are shown in Table X.

**Tetanus** A clinical study (6) of 22 cases of established generalized tetanus seen in and about Cincinnati has failed to show evidence of any beneficial effect of penicillin on the course of this disease. There was no obvious

TABLE X.—SULFONAMIDE RESISTANT PNEUMOCOCCAL INFECTIONS—RESULTS OF PENICILLIN THERAPY

Clinical diagnosis	No. cases	Results			
		Excellent	Good	Questionable	Failure
Bacteremia	33	20	4		9
Empyema	8		8	2	6
Meningitis	9				5
Arthritis					
Pericarditis	1				
Abscess of neck	4		3		
Acute hematogenous osteomyelitis	1				
Peritonitis					



Fig 7 G B a, left, Severe case of gas gangrene complicating compound fracture of tibia and fibula. Infectious process had produced complete gangrene of leg distal to wound and had spread through thigh to inguinal region.

Treatment consisted of midhigh gillbiss neupenicillin parenterally zinc peroxide topically and iv therapy b, Appearance of amputation and shows of amputation has been brought under complete control.

fall in the temperature or pulse rate as has been repeatedly seen in other infections susceptible to its action no decrease in mortality or morbidity nor any definitive decrease in the severity duration or frequency of the convulsive seizures which could be attributed to the action of penicillin. Exceptions were found in cases complicated by pneumonia or other secondary infections susceptible to penicillin in which the improvement that occurred was due to the effect of penicillin on the complicating infection and not on tetanus. The evidence indicates that the successful management of tetanus depends not on chemotherapy but on early diagnosis adequate serotherapy for neutralization of free toxin control of the convulsions and the administration of general supportive measures.

**Human bite infections** When once established this type of infection has been controlled with considerable difficulty in the past. Its necrotizing burrowing characteristics have resulted in prolonged morbidity extensive septic necrosis of the tissues including bone, toxemia, impaired function and even amputation. The results with penicillin therapy in 9 cases have been very promising and they indicate that penicillin is a valuable therapeutic agent for this condition being superior to the sulfonamides. In 5 of the cases the response to paren-

teral penicillin therapy rest, immobilization and elevation was excellent, the infection subsiding quickly and spontaneously with little or no evidence of residual infection or damage. The response was good in 3 other cases when penicillin was used in conjunction with incision and drainage, and questionable in the remaining infection.

**Ratbite fever** Ratbite fever is essentially an invasive wound infection of two clinical types (1) soduku caused by the *Spirillum minus* and (2) the septicemia form produced by *Streptobacillus moniliformis* (10). The endemic Japanese form, soduku, has responded to ampicillin therapy but no satisfactory form of treatment was known for the streptobacillary type. The first 4 cases of ratbite fever caused by the *Streptobacillus moniliformis* which were treated with penicillin were studied at the Cincinnati General Hospital. The results of penicillin therapy in these 4 cases were excellent in 3 with sterilization of the blood stream, early fall in temperature and pulse, disappearance of rash and arthritis, and shortening of the course of the disease. In addition studies *in vitro* indicated that penicillin has a powerful bacteriostatic effect on the *Streptobacillus moniliformis*.

**Gas gangrene.** Penicillin is by far the chemotherapeutic agent of choice in the control of

established gas gangrene. Clinical investigations indicate that parenteral penicillin used in conjunction with surgery gives encouraging results, but only when it is given in relatively large doses of 200 000 to 400 000 units and 800 000 units per day (11 16 18). In a study of experimental gas gangrene (7) the therapeutic value of penicillin has been determined quantitatively.

Average doses of penicillin had no measurable effect but large doses corresponding to approximately 1 000 000 units given every 3 hours had a very definite effect reducing the mortality prolonging the life of the guinea pigs and localizing the lesions. Without surgery however discontinuation of penicillin was followed by prompt spread of the lesion and ultimate death. These experiments indicate clearly that penicillin in large doses is a valuable adjunct to adequate surgery in the treatment of established gas gangrene since it limits the spread of the lesion prolongs the period during which surgical decompression and excision of involved muscles can be done successfully and reduces mortality. This corresponds to the clinical impression of Jeffrey and Thomson obtained in 33 cases of gas gangrene that penicillin can arrest the progressive myositis but that radical surgery is still the main factor in treating the disease. In our clinical experience of 12 cases of gas gangrene the use of penicillin in conjunction with surgical decompression or amputation seemed to be of definite value in overcoming the invasive manifestations of the infection. If the diagnosis was made at an early stage while the gangrene was more or less localized and incipient, radical decompression of the involved fascial compartments by free longitudinal incisions and excision of the infected muscle usually resulted in the arrest of the process and the saving of the extremity. If the diagnosis was made late when the process was extensive and had caused irreversible gangrenous changes in the extremity implying loss of function of the limb open amputation of the guillotine type or some modification became necessary (Fig 7). At the present time it is inconceivable that any type of serotherapy or chemotherapy can replace good surgery in the treatment of gas gangrene.

*Actinomycosis* Penicillin has been much more effective than the sulfonamides in the treatment of actinomycosis but in our experience it is used most effectively in conjunction with sulfadiazine or sulfamerazine. Penicillin given in full doses over a prolonged period of at least 4 to 8 weeks in association with sulfadiazine which is continued under control for an additional 4 to 6 months has given us the best results. Very satisfactory results were obtained in the cervicofacial type and other cases of both abdominal and thoracic actinomycosis have undergone arrest and rather spectacular regression under this management with progressive decrease in size and finally disappearance of the tumor masses and pain. Whether or not complete cures have been obtained in these cases remains to be seen.

#### SUMMARY

It is evident that the sulfonamides and penicillin are very effective and useful agents in the treatment of many infections commonly encountered in the practice of surgery. Penicillin is far superior to the sulfonamides in the treatment of infections caused by the staphylococcus and it has been particularly useful in the cases of infection caused by sulfonamide resistant gonococci hemolytic streptococci and pneumococci. It is also the chemotherapeutic agent of choice in gas gangrene rat bite fever actinomycosis anaerobic streptococcal infections and human bite infections. The use of increasingly large doses of penicillin permitted by its very low toxicity is gradually extending the field of effective chemotherapy in other infections produced by less susceptible bacteria. Penicillin has been strikingly effective in diffuse or generalized staphylococcal infections which have been diagnosed and treated early with penicillin with the exception of those caused by a resistant strain or those complicated by acute vegetative endocarditis. The early treatment of diffuse infections caused by the staphylococcus or streptococcus often was followed by such prompt and complete arrest of the destructive bacterial process that suppuration did not develop and surgical intervention either became unnecessary or limited to more localized measures. In



the management of suppurating surgical infections caused by susceptible bacteria, penicillin therapy has had a striking beneficial effect on mortality and morbidity but the fundamental surgical principles of early accurate diagnosis early treatment rest, adequate external drainage correction of altered physiology and vigilant supportive treatment remain as important as ever

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# CANCELLOUS BONE GRAFTS TO THE JAW

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THE problem of bone grafting in the lower jaw merits serious consideration even though it is met with infrequently in civilian practice. Distortion of appearance which results from mandibular loss in the course of surgery of malignancy and following severe infection or trauma is secondary in importance to disturbance of

speech and to the impairment of mastication and deglutition which affects profoundly the individual's entire nutritional status. In war surgery the necessity of bone grafting to the lower face arises rather commonly because of the high incidence of massive maxillofacial injuries from bullets and shell fragments.

Mandibular bone grafts were first employed 30 years ago during World War I by the German, French and English American groups of workers with perhaps a thousand cases re-

Presented in the symposium on Plastic Surgery of the Head and Neck, before the Clinical Congress of the American College of Surgeons, Cleveland, Ohio, December 16-20, 1946.

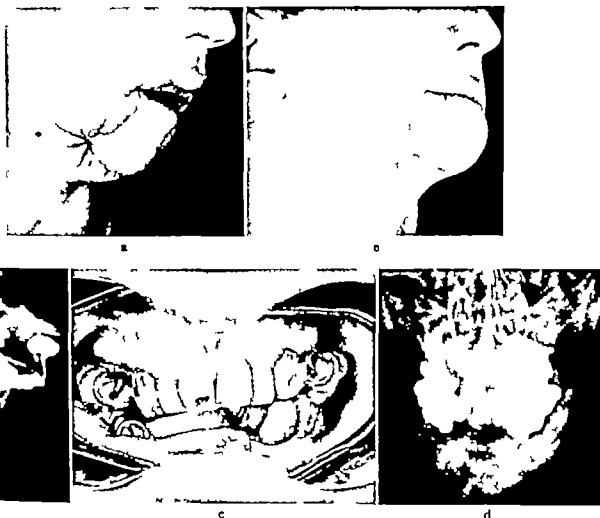


Fig. 1. O. R. L., M.C., age 31 years, received a shell fragment wound June 29, 1944, with loss of considerable soft tissue of the chin and bony loss of the symphysis and anterior half of the right body of the mandible. It was necessary to readjust soft tissues for better coverage before insertion of a bone graft, and a labioalveolar sulcus was created later by a stent graft in order that a functioning

denture could be used. a, Appearance on admission. b, Roentgenogram showing bone loss. c, Interlocking cap metal splint for immobilization. d, Roentgenogram showing cancellous bone graft bridging the defect. e, Appearance following bone graft.

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Fig. 2. B. N. Pvt. age 24 years, received a machinegun bullet wound of the face with loss of the greater portion of the left body and angle of the mandible, March, 1944. a, Appearance before operation after subsidence of reaction. b, Roentgenogram on admission showing large loss of substance on the left and no osseous on the right. c, Flange cap metal splint to maintain the fragment in normal position during the healing period and at the same time allow function of the jaw. d, Interlocking cap metal splint, used for immobilization of the jaw after operation. e, Roentgenogram showing large cancellous bone graft in position. f, Stent graft to create sulcus for denture. g, Final denture before disposition. h, Final contour. (b, g are reproduced through courtesy of the J. B. Lippincott Company from article by Blocker.)

ported in all. A variety of sources were employed in the remedy of small losses of bone and in ununited fractures. These include

1. Sliding or pedicle grafts from the mandible for losses not greater than 3 centimeters in the symphysis or body.

2. Cortical grafts from the tibia.

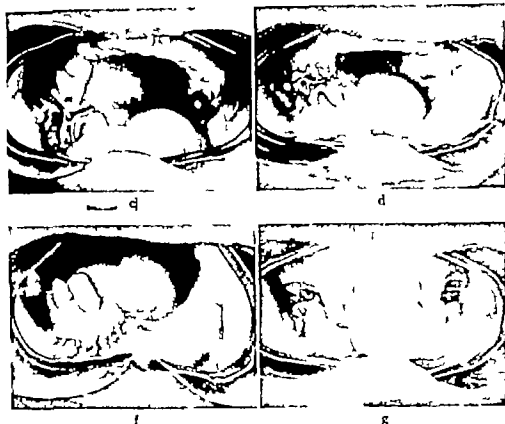
3. Osteoperiosteal grafts—thin shavings of bone and periosteum about 2 millimeters in thickness—for small bony defects not associated with disturbance of contour.

4. Rib grafts.

5. Clavicle grafts employed in pedicles from the neck for restoration of the symphysis and overlying soft structures of the chin.

6. Grafts from the ilium, particularly for large losses of bone and distortion of normal contour.

During recent years the use of iliac grafts has been the method of choice although some workers, notably Barrett Brown, employ the rib whenever practicable.



(Legend on opposite page)

The literature on theories as to the mechanism of bone regeneration is voluminous and has influenced considerably the operative technique. For a long time it was felt that periosteum was indispensable but experimental and clinical evidence has demonstrated that neither periosteum nor cortical bone is necessary for successful grafting. The superior qualities of cancellous or spongy bone provide for rapid vascularization and earlier stabilization and union for this reason small chips of part-cortical part-cancellous bone are becoming increasingly popular in orthopedic and maxillofacial surgery when it is felt that immobilization can be maintained without the use of cortical bone as a splint for fragments. The employment of large blocks of pure cancellous bone from the ilium is the most recent innovation in bone grafting. And while other workers may be able to demonstrate equally good results with other methods of reconstruction of mandibular defects we have found cancellous block grafts an extremely satisfactory medium of repair. The ilium is readily accessible and furnishes a large amount of available spongy bone. Following removal

of all cortex the graft is easily cut and shaped to fit the requirements of the individual case. The use of chips alone is rather haphazard and it is difficult to maintain good contour. For extensive defects such as angle-to-angle loss of bone we have employed at times a tantalum tray to give proper shape to the jaw. In these cases more than one block graft is used, and cancellous chips are packed around the open spaces.

With present-day dental appliances there need be no dependence on the mandibular graft for any part of fixation. Cancellous bone very quickly develops strength and evidence of firm bony union within 8 to 14 weeks time after operation when dentures may usually be fitted. We have been able to observe grafts directly 5 to 6 months after surgery when exposure is made to add a cartilage implant for improvement of chin contour. They show smooth white bone with a well-developed pseudoperiosteum and on stripping of this membrane numerous nutrient vessels are seen entering the bone.

The most important requirements for success in bone transplantation are adequate sup-

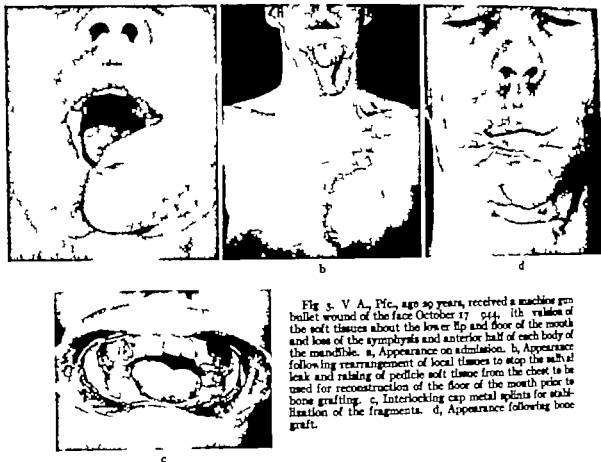


Fig. 3. V. A. Mc., age 30 years, received a machine gun bullet wound of the face October 17, 1944, with violation of the soft tissues about the lower lip and floor of the mouth and loss of the symphysis and anterior half of each body of the mandible. a, Appearance on admission. b, Appearance following rearrangement of local tissues to stop the salivary leak and raising of pedicle soft tissue from the chest to be used for reconstruction of the floor of the mouth prior to bone grafting. c, Interlocking cap metal splints for stabilization of the fragments. d, Appearance following bone graft.

ple cover free of scar tissue and induration, absence of infection and avoidance of contamination at the time of operation and proper preoperative and postoperative immobilization of fragments. The necessity of having resilient soft tissue covering has not been adequately stressed and here time is an inescapable factor in the elimination of wound reaction. For avulsion deformities pedicle flaps from the thorax and abdomen must be employed. Less severe defects may be taken care of by rotational flaps and other methods of rearrangement of local tissues. Even small adherent scars should be removed several weeks before bone grafting with complete excision and wide undermining to give relaxation in closure. Operation should never be performed through a wide cicatrix or through an indurated area. Removal of loose sequestra and fragments of teeth hastens the subsidence of localized drainage and infection. We are not yet convinced that early operation is advisable

even with the use of penicillin and it has been our custom to delay bone grafting for a minimum period of 2 months following last drainage from the area. The great majority of our cases have waited over 6 months after subsidence of active evidence of infection.

Bone grafting to the jaw requires close cooperation of both surgeon and dentist. The dental surgeon assumes charge of all mechanical devices for immobilization of fragments before and at the time of operation and looks after the patient's oral and dental hygiene. Proper emphasis must be placed upon improvement of the general physical condition as well with correction of anemia, weight loss, and protein imbalance.

The chief problem in individual bone graft procedures of the mandible is the method of fixation and immobilization to be employed. Various factors must be taken into consideration: size and character of the defect, position of teeth in the upper and lower jaw and state



Fig. 4. R. M. B. Corporal aged 25 years, received a shell fragment wound June 10, 1944, with avulsion of soft tissues of the chin and floor of the mouth and loss of the right body and symphysis of the mandible. a, Appearance on admission showing granulations and draining sinuses.

b, Exposure of mandibular defect at operation 1 year after admission. Soft tissue loss has been replaced with a pedicle flap from the chest. c, Tantalum tray containing cancellous block graft. d, Appearance following operation. e, Profile view.

of occlusion of the fragments. Because of the danger of opening into the oral cavity at the time of operation the position of fragments cannot be altered at that time except in angle defects or where the fragments are edentulous.

If both fragments are edentulous some modification of the Gunning splint is used during the waiting period and also following bone grafting. At operation we usually employ some type of internal fixation such as a piece of perforated tantalum shaped over an impression of a normal cadaver mandible.

Where one fragment is edentulous and the other contains teeth the latter is kept in occlusion by a flange splint. The edentulous portion at operation is liberated on all surfaces, placed as nearly as possible into normal

position and maintained there by a wire through the angle tip or ramus which protrudes through the skin and attaches to a bar coming around the face from the intraoral splint.

Where both fragments contain teeth a cap metal splint with rigid crossbar is very satisfactory preoperatively. At the time of insertion of the graft two interlocking cap metal splints are used to hold the jaws absolutely immobilized. At the time of operation we have employed either endotracheal anesthesia or a combination of (1) high bilateral intraoral mandibular block with 2 per cent novocain (2) local novocain infiltration and (3) spinal anesthesia for removal of bone from the ilium. We prefer the second method because of the advantage of novocain adrenalin solution in

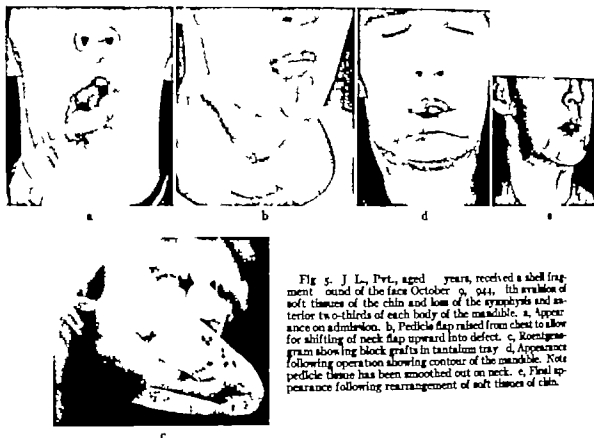


Fig. 5. J. L., Pvt., aged years, received a shell fragment round of the face October 9, 1944, with avulsion of soft tissues of the chin and loss of the symphysis and anterior two-thirds of each body of the mandible. a, Appearance on admission. b, Pedicle flap raised from chest to allow for shifting of neck flap upward into defect. c, Roentgenogram showing block grafts in tantalum tray. d, Appearance following operation showing contour of the mandible. Note pedicle tissue has been smoothed out on neck. e, Final appearance following rearrangement of soft tissues of chin.

minimizing bleeding in the operative field. In addition the patient is less likely to develop postoperative respiratory distress and nausea when a general anesthesia can be avoided.

#### TECHNIQUE

The operative technique is as follows:

Incision is made parallel to the lower border of the mandible with care taken to prevent injury to the mandibular branch of the facial nerve. This nerve can be avoided by dissection downward external to the platysma for about 2 centimeters below the inferior border before approach is made to the bone fragments. About 2 centimeters of bone is exposed on each side where fragments contain teeth. For ramus, angle, or posterior edentulous fragments exposure can be made by stripping the periosteum for long distances without danger of entering the oral cavity. Edentulous fragments are detached thoroughly and replaced in normal position.

Eburnated ends of fragments are cut off by sharp rongeurs, and the outer cortex of the

mandible in the recipient areas is removed with a dental burr until an area of bleeding bone sufficient for good contact is obtained.

Meanwhile the iliac crest has been exposed subperiosteally by another operative team. A large section of ilium is cut out with a sharp osteotome and placed on a wooden block for removal of all cortical bone, which is then discarded. The donor area is closed in layers with a deep removable No. 32 wire suture and No. 36 interrupted sutures are used for the skin. Pressure dressing is applied.

The graft is shaped with sharp-cutting rongeurs, and all cancellous chips are saved to be packed later into open spaces in the graft bed. The transplant is placed in position as both an inlay and onlay graft and is immobilized by a single strand of No. 32 stainless steel wire at each end. At least 2 centimeters should be in contact with the bleeding bone on each fragment. Although there may be marked protuberance externally at first, rapid absorption takes place and the contour of the mandible is quickly established after function begins.



Fig. 6. F W P. Pvt., aged 20 years, received a shell fragment wound July 7, 1944, with avulsion of the lower lip, chin, and floor of the mouth, and loss of the symphysis and anterior one-third of each body of the mandible. a, Appearance 3 months after injury. b, Pedicle flap in position. c, Roentgenogram showing bone loss. d, Interlocking cap metal splint used for immobilization of fragments before bone grafting. e, Roentgenogram showing bone graft in position. f, Appearance following firm bony union. g, Appearance following excision of outer covering of flap and replacement with skin from the face. Further "touching-up" procedures are yet to be carried out.

Complete hemostasis is obtained by ligation of all bleeding points with No. 40 wire. Closure is made in layers, and firm pressure dressing is applied. It cannot be too strongly em-

phasized that there must be no tension on the wound edges and it may be necessary for proper relaxation of the tissues to undermine the skin for considerable distance.





Fig 7. J. P. P. Pvt., aged 39 years, received shell fragment wound of the face June 24, 1944, with fracture of the left mandible and maxilla. Following removal of an unsuccessful cartilage graft because of drainage, a large cancellous bone graft was placed over the remaining portion of the maxilla, with good contour resulting. a, Appearance on admission. b, Final contour.

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Fig 8. C. C. Mc., aged 39 years, received shell fragment wound of the face July 5, 1944, with avulsion of soft tissue and loss of the major portion of the left maxilla. The soft tissue loss was replaced by pedicle skin prior to restoration of contour by cancellous bone graft. a, Appearance on admission. b, Appearance following operation. It is planned to remove the outer covering of the pedicle flap as completely as possible at a later date and replace it with a rotational flap from the neck.

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In over half of our cases closure was made with fine silk, but as we felt that in two instances drainage occurred as a result of buried silk sutures, we began to use a single removable stainless No. 36 wire for the deeper layers and continuous running stitch of No. 38 wire for the skin.

#### AFTER-CARE

Postoperatively patients are kept in a semi-sitting position and watched closely for evidence of respiratory difficulty. In one instance we found it necessary to open an intraoral splint for 24 hours to relieve obstruction. Liquids are given by syringe or tube and gradually the patients learn to put semisolid foods around the splints with the fingers. Protein and vitamin intake is given careful attention.

Routinely we have given for 5 days postoperatively 20,000 units of penicillin in  $\frac{1}{4}$  per cent novocain solution every 3 hours. Pressure dressings to both donor area and face are maintained for 10 days, and frequent mouth wash is used for oral hygiene. Patients are usually ambulatory by the end of 2 weeks. After 7 or 8 weeks the cap metal splints are released, and the state of clinical union is inspected. If the fragments are not absolutely rigid, splints are left in place for another 2 to 4 weeks before removal. Dentures are fitted within 8 to 14 weeks if normal buccal and labiodental sulci are present. Otherwise these must be reconstructed by stent grafts 4 to 6 months later.

During the past 2½ years we have seen in an army plastic surgery center 68 patients who have required bone grafting because of mandibular loss greater than 2 centimeters. Eight of these showed massive avulsion wounds which required replacement of soft structures by pedicle flaps prior to bone grafting. Two of the 68 patients are still waiting final operation pending subsidence of tissue reaction.

In the remaining 66 cases blocks of pure cancellous bone from the ilium have been employed for defects varying from 3 to 15 centimeters in length. Drainage has occurred in 10 instances twice from buried silk, three

times from inadequate coverage and in 5 cases from accidental opening into the oral cavity. Half of these cases have had successful union in spite of drainage. Four have had partial loss of graft. 2 of these have since been regrafted without complication. In the fifth case it was necessary to remove the transplant because of infection. Failure has been attributed in 3 instances to insufficient cover plus difficulty in fixation for one reason or another in 2 there had been infection following entrance into the mouth.

No disability has been noted in any patient from the removal of bone from the ilium. Drainage has occurred in 2 instances once from buried silk and once from a small piece of rubber tissue inadvertently left in the wound.

In addition to 68 bone grafting procedures to the mandible in 66 patients cancellous iliac grafts have been employed for restoration of contour in 18 deformities of the maxilla. 5 of the nose and 2 of the supraorbital margin. Drainage occurred in one instance but successful final union was obtained in every one of these cases.

#### SUMMARY

In summary we believe that iliac block grafts of pure cancellous bone form the most satisfactory material for relief of large and small bony defects in the mandible. The large percentage of cases without failure cannot be attributed to the choice of graft alone however. We must not overlook the value of chemotherapy in the treatment and prevention of infection nor disregard the importance of suitable mechanical fixation of fragments. Above all we must not forget that the background of all transplantation procedures is the proper preparation of the tissues themselves. In no other branch of surgery is the old adage so true, that haste makes waste.

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# MODERN METHODS IN THE TREATMENT OF FRACTURES

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**I**N the early days of the human race, nearly all fractures were caused by falling from a sufficient height and were usually simple fractures of the long bones. As the centuries rolled by and warfare became developed to a higher grade than wooden clubs and stone axes, compound fractures became more common and were less easily repaired. With the advent of gun powder and the hazards of more rapid transportation fractures occurred with much greater frequency and began to attract the serious consideration of the physicians and surgeons of those times.

Seventy years ago a compound fracture of an arm or leg almost invariably required immediate amputation to save the patient's life, but the development of antiseptic and aseptic methods of treatment began to offer more hope of saving these damaged limbs. Forty years ago the rapidly increasing numbers of automobiles introduced the tremendous risks of high speed travel on the highways and the byways of the world. Thirty years ago the first World War produced the enormous dangers of high explosives and fast airplanes and these dangers were multiplied many times over in the war which ended only last year. Or has it really ended?

What has been learned in the last few decades about the treatment of fractures? Since 1900 forty six years ago I have been interested in orthopedic surgery and in fractures. I have seen the rise and sometimes the fall of many different methods and ideas in the treatment of broken bones.

The one dominant purpose of treatment is to produce a satisfactory union of the fracture, with re-establishment of the normal function in the shortest possible time.

In the Fracture Oration of 1935 Paul Magnuson presented briefly and graphically

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Fracture Oration, presented before the Clinical Congress of the American College of Surgeons, Cleveland, Ohio, December 26-30, 1935.

the salient points of fracture treatment from the days of the Egyptians 4500 years ago, the Hippocratic era 2400 years ago, and the works of Galen up to the year 900 Anno Domini. Then came the long centuries of the Dark Ages when no progress was recorded until the Renaissance. In the 14th century interest in fractures was revived and from that time the value of many of the almost forgotten old principles began to be recognized. Methods of traction and countertraction, the basic foundation of the treatment of fractures of the long bones, became simplified and improved. Buck's extension Thomas's splint (which was originally designed for knee disorders) and the Hodgen suspension splint gradually assumed their well deserved importance, together with the improved types of adhesive plaster. Then in 1895 came Roentgen's discovery of the x ray which visualized both the good and the bad results of treatment, and made possible some much needed improvements in the handling of fractures.

Now it became easy to determine accurately whether or not the alignment of a fractured femur was satisfactory or whether the traction was pulling the bones too far apart.

Next came the development of skeletal traction by Steinmann's pin and Kirschner's wire, in cases in which adhesive plaster could not be used. These devices were not free from the danger of infection and had to be carefully watched.

In 1910 Arbuthnot Lane popularized his method of applying a steel plate, by open operation screwing it across the fracture line by four or six or eight screws. This simple and easy way of reducing and securing fractures of the long bones swept the country like a tornado. It seemed so rational and so satisfactory that hundreds of surgeons purchased the plates and the few special instruments, and without following the meticulous technique perfected by the originator proceeded to plate many simple fractures of the long bones. I do not know how many times I have been asked

to see a boy or a girl with a fractured femur who was about to have a Lane plate applied by an enthusiastic surgeon. In most of these cases when it was explained that the overriding and the malposition could be corrected by a few days of traction and suspension in a comfortable Thomas splint, and that in 6 or 8 weeks union would be strong enough for a caliper splint or a plaster-of Paris spica the doctor and the patient were willing to avoid the operation.

There are two basic reasons entirely apart from the danger of infection why a plate of the Lane type or the Sherman type or any similar type is not the ideal method of treatment. First, it does not immobilize the fracture completely, because a certain small amount of motion will always be present in rotation and in lateral bending toward the plate. Both of these motions could be avoided by applying a similar plate to the opposite side of the bone but few surgeons have had the hardihood to attack the bone on both sides. In oblique fractures a transfixion screw applied at right angles to the line of fracture will prevent most of the mobility but does not work so well in transverse fractures. Secondly, when a Lane plate is applied the ends of the fragments undergo a small amount of absorption so that a definite space is left between the ends. It is true that in many cases enough new bone is formed to obliterate this empty space, and the fracture unites but it does not unite as rapidly as it would if the bone ends were in firm contact. Moreover the external callus formation develops upon the opposite side of the fracture and does not cover the plate, except in children so that the ultimate ossification of the fibrous tissue between the ends of the bones is greatly delayed. This external callus may become very large when the immobilization of the fracture is inadequate. Even a long plaster-of Paris cast, from the chest to the toes does not furnish complete immobilization in most cases of fracture of the shaft of the femur.

I do not deny that in many hospitals and clinics the plating of simple fractures of the long bones has shown excellent results but such operations should be performed only when a satisfactory result cannot be obtained

by conservative mechanical means and when the surgical standards of the operator and of the hospital are of the very highest grade.

Because of the many disappointments following the widespread use of the early types of the Lane plates whether from mechanical defects technical errors or infections, other investigators have been busily devising different methods. The old and reliable principles of manual reposition traction and counter traction and fixation by plaster of Paris and splints have become less understood and less popular. This I think is largely due to the fact that the conservative mechanical treatment of long bone fractures requires the careful time consuming attention of the surgeon himself. He cannot safely delegate this attention to anyone else. A leg or an arm in a traction apparatus must be seen every day by the man who is responsible for the ultimate result. Residents and internes do not always notice that the adhesive plaster is cutting into the skin or is losing its pull at important points. Because this constant attention is necessary and because a day has only so many hours, it is perfectly natural that busy surgeons should welcome any methods which would reduce the time element required for proper results. If such methods are safe, sane and satisfactory we should use them but we must always remember that the union of a fracture takes so many weeks or so many months and that we cannot make broken bones grow together any faster in 1946 than the Egyptians could four thousand years ago.

What are some of these newer methods and to what extent can they be recommended for general use?

Many years ago various types of nails and screws were employed in attempts to fasten together the broken bones. Considerable success resulted in many cases but the ever present danger of infection made such treatment always a definite hazard. The advent of the sulfa drugs penicillin and other fungus derivatives has removed some of these dangers but there is still no substitute for aseptic surgical technique. Stainless steel and vitallium have replaced iron and plain steel and we can no longer use metals which undergo erosion or cause electrolytic reactions in the

body tissues. Metallic fixation of fractures has assumed a very important place in bone surgery especially in certain kinds of fractures. The neck of the femur the olecranon process of the ulna, the patella, and the shaft of the tibia may present problems which may legitimately be considered suitable for open operation. Years ago Kellogg Speed in one of these Fracture Orations applied the name 'The Unsolved Fracture' to the very dangerous fracture of the neck of the femur. The medical literature has been full of articles about different methods and devices for the treatment of this lesion. When I was a young man some of the surgeons were using carpenter's screws or nails, with occasional success but with frequent failure. Smith Petersen's three-flanged nail was an enormous improvement over the earlier types, but even today there are clinics where lag-screws, threaded wires, and other devices are preferred to the flanged nail.

Some of the recent publications do not emphasize sufficiently the enormous necessity of accurate reduction of the fracture before it is nailed or screwed. In many of the articles, roentgenograms are shown which reveal imperfect replacement of the fracture before the nail was inserted. This did not always produce a failure of union but it is certainly not desirable and it is usually the result of inadequate x ray control. Anteroposterior x ray films cannot be relied upon to show accurate reduction of the fractured ends and it is extremely difficult to make satisfactory lateral films with the patient's legs fixed firmly in the traction apparatus. No surgeon should attempt to nail a fracture of the neck of the femur unless he can obtain good lateral films on the operating table at all stages of the operation, without disturbing the hip-joint or the operative technique. This means that such patients should be cared for in a hospital with all of the requisite equipment and personnel. It is major surgery of the most difficult type.

The purpose of this lengthy discussion is to emphasize the tremendous importance of developing in every community a team of surgeons who will be able to treat properly the cases of fracture of the neck of the femur and who will have the requisite instruments and

x ray facilities and technicians, without which no one can accurately reduce and nail such fractures. One day in August I examined the x ray films of 3 cases of this kind which had been nailed in other cities. Not one of these fractures had been properly reduced before the nailing and all 3 had failed to unite. It is highly probable that these unfortunate results were due to imperfect lateral x ray films made on the operating table, and I have seen many similar examples, 2 of them occurring in my own practice. Unless the x-ray control is clear and accurate it will be necessary to open the hip-joint in order to be sure that the reduction is satisfactory and that the nail is put in the proper place. This type of open operation adds greatly to the danger of shock and of infection and is practically never necessary when good x ray films are available during the operative procedures.

To make my position perfectly clear the following plan seems to be the best for the treatment of fractures of the neck of the femur.

The patient is placed upon an orthopedic traction table of the Albee, Hawley McKenna, or similar type. The displacement is carefully reduced by the Leadbetter maneuver or by traction. X ray films are made in anteroposterior and lateral planes, one of the two portable tubes being located between the thighs, the other directly over the hip-joint and two or three feet above the field of operation. The perineal post on the sacral support should be of wood or aluminum, so that no manipulation will be necessary for the lateral views. When the reduction is shown to be satisfactory both legs are securely fastened to the traction apparatus. A 5 inch incision is now made to expose the outer surface of the femur and a long wire marked in half inches, is drilled upward and inward from a point well below the trochanter. It is wise to make a hole through the outer cortex with a quarter-inch drill before starting the wire, so that the direction of the wire can more easily be changed without blinding or bending in the thick cortex. When the wire has been inserted to a depth of 3 or  $3\frac{1}{4}$  inches, new x-ray films are made to check its position. If not satisfactory the wire is withdrawn and reinserted until it is

in proper position. This may require one or two trials, with corresponding x ray films. A little time may be saved by using another wire, leaving the first in place as a guide. When the position is found to be correct, a cannulated stainless steel or vitallium Smith Petersen nail is threaded upon the wire and is driven along it into the neck and head of the femur. The length of the nail is estimated by the calibrations of the wire. Again x ray films are made in both directions, and if satisfactory the wire is pulled out and the wound closed.

You will see from this description the enormous importance of the x ray examinations, and the complete futility of attempting this kind of operation unless such rapid and accurate roentgenographic control can be furnished. Good anteroposterior views can be made with great ease but the lateral views require special equipment and technique.

I have not mentioned the use of screws lag screws, or the various threaded or unthreaded wires, because I believe that the Smith Petersen Johansson nail is better than any of them for general use.

A few words about the after treatment. Over the usual dressings a firm, elastic spica bandage should be applied from the waist to the knee, and a foot-piece or sling should be used to prevent outward rotation of the thigh.

It is important to prevent outward rotation of the thigh as the patient lies in bed because the weight of the thigh and leg exert a downward and outward pull upon the nail tending to separate the fragments. It is not wise to allow early sitting and standing without some form of partial immobilization of the affected hip although some writers encourage it.

We must remember that at least 4 months are required for bony union in these cases and that union is made by the internal deposit of new bone, and not by external callus formation.

Septic or avascular necrosis of the femoral head is a complication of intracapsular fractures seen less frequently than after dislocations of the hip but nevertheless sufficiently often to influence the ultimate prognosis. The artery in the ligamentum teres supplies only a small portion of the head, and, indeed is some-

times absent. The main blood supply comes from the arteries of the capsule and if these arteries are occluded or are too small the head becomes necrotic. At present, there is no certain means of improving the blood supply although drilling and bone-grafts offer some hope. Perhaps the best form of treatment is to prevent any weight bearing on the femoral head by the use of crutches and a caliper splint, or by long-continued traction trusting that Nature will provide a new blood supply by the slow in-growth of small arterioles and by creeping substitution. This requires a long time and in some cases fails to occur in which event the patient has a painful and disabled hip-joint which may need a reconstruction operation or an arthrodesis to produce an ankylosis of the joint.

Let us now consider the other types of fractures which may usually be considered suitable for operative treatment. The patella and the olecranon process of the ulna if the fragments are widely separated will unite more satisfactorily and more rapidly if they are mechanically fastened together by one of the accepted operative methods. Spiral or oblique fractures of the shaft of the tibia may be extremely difficult to retain in good position by conservative treatment and it may be wise in such cases, to fix the fragments together by transfixion screws, or even by stainless steel plates. The fibula unites much more rapidly than does the tibia and sometimes holds the fractured surfaces of the tibia so far apart that they cannot unite. Cases of this kind require operation.

For many years the surgical literature has been flooded with articles advocating the use of mechanical devices for the reduction and the fixation of fractures of the long bones. The catalogues of the instrument makers and the published articles of the designers show in fascinating detail the very ingenious devices and the remarkably successful results. The basic principle of all of these contrivances is identical. This principle is to drill two strong pins into the shaft of the bone above the fracture and two more similar pins below the fracture as far away from the fracture itself as possible and to connect each pair of pins with a clamp to hold them rigidly to-

gether. These two units are then used to manipulate the fractured ends into accurate apposition. In difficult cases an ingenious traction frame has been devised to aid in this manipulation. When good position has been attained, the pin units are connected by rods clamped firmly to them, or by short plaster-of-Paris casts molded around the pins. It is not to be denied that this method is very valuable in certain types of fractures. It furnishes good apposition and good control of nearly all types of fractures, and allows early and free movement of the joints at either end of the broken bone. It is, however, neither so simple nor so safe as the inventors and manufacturers would have us believe. It requires considerable skill and experience to drill the pins into the proper positions, whether the pins go entirely through the limb or stop after penetrating both cortices of the bone and project only from one side of the limb. It is also not easy to prevent infection from occurring along the track of the pins, as there is always some seeping discharge from the pin holes, but the advocates of the method state that osteomyelitis is very rare.

The best known of these devices are the Stader, the Haynes, the Griswold and the Roger Anderson types, and of these the Anderson instruments seem to be the most generally satisfactory. They are all modifications and improvements of the old Lambotte ideas, and in a very small proportion of fractures they may be very useful.

Another revival of ancient methods was described by Kuntscher in 1940, who drove a long steel rod into one end of a fractured long bone down through the medullary canal across

the line of fracture. These rods were used chiefly in Germany during the second World War and have achieved some popularity in the United States. One of the advantages of this method is that the broken ends of the bone are pulled into close apposition by the action of the muscles, so that union is much more rapid than when Lane plates are used. The fact that the medullary canal is plugged up by the rod seems to have no deterrent effect upon the union of the fracture.

About thirty years ago Hey Groves treated a fracture of the upper third of the femur in this way using an iron rod, but he complained that the rod was not strong enough to resist the muscle-pull, and so the femur became bent at an angle. If he had put the leg up in a Thomas splint or in plain traction apparatus, after the operation, the result might have been better. With the new stainless steels, the method may be useful in selected cases.

It must be admitted, in discussing the various kinds of operative treatment of simple fractures, that the advent of the sulfa drugs and the fungus derivatives has made open surgery much safer than it was a few years ago, but we must not lose sight of the fact that the majority of fractures can be treated successfully by the older conservative methods. We are going through a transitional period at the present time, both surgically and politically, and I do not want our young physicians impressed with the idea that fracture treatment necessarily means a machine-shop full of tools to repair every kind of broken bone.

The best fracture surgeon uses the fewest gadgets.

# THE SURGEON AND HIS TRUST

With Special Reference to Safe Conduct of the Patient through Operation

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THE safe conduct of a patient through operation demands the following (1) adequate preparation of the surgeon (2) careful and precise preparation of the dissection (3) satisfactory preparation of the patient after operation. All of these items are important. Inasmuch as many of the important items relating to care of the patient before and after operation the subject of this symposium discussion have been dealt with in an eminently satisfactory manner by the other participants I have elected to devote my remarks principally to a somewhat philosophic consideration of the surgeon's own preparation for his responsible tasks. I do not interpret my opportunity of speaking last as affording me the privilege of acting as moderator in this discussion. In the final analysis, you and time are the ultimate arbiters and umpires of what is said here.

## THE FUNCTIONS OF SURGERY

The very nature of surgery stamps it as a sacred trust. By general agreement, surgery is invoked only when the desired objective cannot be achieved satisfactorily by non-surgical means. It is the purpose of surgery to preserve life and to restore normal function in so far as is possible and at the least risk to life and without compromise of the patient's future welfare.

## FORMALITIES OF SURGERY

Any enterprise which achieves its ends through employment of such extreme means as surgery must of necessity observe certain formalities. In saying this I am not alluding to fatuous conventions and empty ceremonies but to compliance with rules of conduct which

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time and practice have shown to be valuable guides.

The items listed above which have to do with the safe conduct of a patient through operation are mutually interdependent. One component is unlikely to afford promise of success without the co-operation of the others. A well trained surgeon who comes well prepared for the operation and who performs a superb dissection but who neglects the preparation of his patient before operation or his care after operation is not doing the best for his patient, and the surgeon who bungles the dissection stands in the way of recovery of his patient. Yes, poor preparation of the dissection is alas the agency through which some patients who undergo surgery with the hope of having their lives made happier and longer have them shortened. How poor management of the problem of hemostasis in any type of surgery but particularly in operations involving large blood vessels or performance of an anastomosis in the gastrointestinal canal which is architecturally unsound may shorten the lives of patients needs no elaboration. What surgeon would not prize highly an opportunity to be given a second chance to rectify an error of commission which shortened a patient's life? But an operation like any biological experiment is performed only once. Why not prepare well for it? Death is so final!

Yet, we see surgeons hurrying through operations as though their time were more important than the safety of the patient. Has not the fallacy of the 'get in quick and out quicker' approach to surgical problems been exposed sufficiently? No amount of best care before and after operation can undo the harm of an operation badly performed.

Wise surgical planning limits the surgeon's range of activity. The Army Medical Corps in World War II had a record of accomplishment in the management of difficult surgical problems which was unique in the annals of medi-



cine. The success of that undertaking was the result of planning organization and the selection of individuals with satisfactory training to do a given job. In our own work, we are left largely to our own devices in these matters. The product of our endeavors is dependent in large measure upon how well we have planned and the care with which organizational detail has been carried out. The range of operations which any one surgeon may perform is also a matter of personal choice. This latter item is a matter which demands some standardization among surgeons, just as much as particulars of planning and organization. There are still a few surgeons who affect to believe that they can take all of surgery for their province. They know as well as anyone that their performance in such a wide category of operative procedure is substandard in some of these areas, when judged in the critical light of what constitutes good practice. If a surgeon has not the moral courage to say to himself occasionally "The interests of this patient are served better by having someone more intimately acquainted with the problem undertake this task than I" when will society or medicine set up an advisory group with authority to decide for us that which we have been unable to decide for ourselves?

Even among teachers of surgery who have a better opportunity for continued self-improvement than the rank and file of surgeons, there are still a few who essay to embrace a large portion of all of surgery. In our time, we have seen the province of the general surgeon shrink so much so that occasionally we wonder what areas of surgery are embraced in the designation general surgery. Yet, this is as it should be. If a teacher of surgery were so ardent a student of his art that he wished to encompass the entire field, an aspiration more ambitious than praiseworthy, he would remain all his days a learner and would thereby lose the important opportunity to give directional growth to a smaller sphere of surgery. Teachers of surgery must prove themselves in the next generation as well as in this. The teacher who leaves no pupils or intellectual progeny has not been fully alive to his responsibilities or wholly faithful to his trust

*The passing of the all-around surgical specialist.* The sprouting of many surgical specialties from the parent stem of general surgery affords some indication of how surgery has grown. Moreover sharper lines of distinction between the various surgical specialties are being drawn. The specialty boards are playing an important rôle in lending acceleration to this transition. In some clinics not so long ago one could see a surgeon, in a single day's work, do a stomach operation or two, a few operations upon the biliary tract, as well as the colon and rectum, and perhaps a few goiters and a breast operation or two in addition and then extend himself into the province of the urologist, gynecologist, and orthopedist. Let us be thankful that the day of the all-around surgical specialist is done! Surgery is not advanced by that type of activity and no matter how talented the surgeon he cannot do equally as good work in all these provinces.

The background of training of the surgeon should be broad. But having acquired orientation and competence, a surgeon must of necessity if he aspires to rise above mediocrity give selective direction to his activity instead of trying to grow in all directions simultaneously. The public has the right to demand a high standard of performance from us. Moreover we are all debtors to our profession and from those of us who have enjoyed opportunities above the ordinary society reasonably may expect that we should strive to add something to the sum total of knowledge rather than continue to be parasites upon our common heritage.

*The responsibility of higher institutions of learning to surgery.* Surgery has been enriched from many sources. Our institutions of higher learning have a responsibility for leadership in surgical education in this country—not alone to train students for the practice of surgery and to help them meet the requirements of the Specialty Boards, but also for the great task of improving surgery. Recognition of the tremendous importance of research in lending accelerated momentum to the slow growth of knowledge is a part of that responsibility. Knowledge can come to have new meaning with synthesis of well known

facts and much of surgery's progress in the past decade has been compounded out of well known facts becoming known to the right persons. It is to the discovery of new fact however that we look hopefully to the future for significant changes and improvements in surgery that will have the same impact upon our lives as did the discovery of anesthesia and asepsis.

*The acquisition of surgical techniques* The acquisition of skills is an interesting study. Those of us who have been privileged to be teachers of surgery and who have nurtured young surgical plants have had a unique opportunity to observe how such seedlings grow. Given a good brand of 'plant' with a high native intelligence and a real capacity for application accompanied by an intense and unflagging interest in surgery together with a sympathetic understanding of the frailties of man the capacity for growth of such an individual is almost limitless. And if in addition he is possessed of an inextinguishable yearning to add his bit, whether large or small, to the sum total of surgical knowledge there is no telling how far he may go. That he will surpass his teacher in accomplishment is self-evident. There is a certain inertia or lag in the learning process when progress is made slowly if not almost imperceptibly. But all of a sudden the man who just yesterday seemed almost a novice becomes an accomplished technical surgeon. The circumstances which bring about this accelerated spurt of growth are difficult of assessment and are not readily defined. It is not a process that can be hurried but a development which must come naturally through a certain sequence of events which by no means is the same for all individuals. This development has to do with the surgical neophyte becoming steeped in the practices, techniques and procedures as well as the general approach of a surgical service to problems. In this learning process, acquaintance and an increasing familiarity with the numerous facets of individual surgical problems as they relate themselves to physiology, biochemistry or bacteriology are very important. This period of training constitutes essentially an apprenticeship. For the finished surgeon it is a *sine*

*qua non*. The surgeon who is self taught is distinguished readily from the person who has pursued this more rigorous and orthodox scheme of training. And how quickly the surgeon of ability who has traveled this devious and stony path learns to master the technical phases of difficult operations is always a source of amazement and gratification to me. It is a metamorphosis in which the co-ordination of eye, mind and hand are important. The man who can grasp the problem and transmit to his hand what the eye sees and exact from this eye to mind to hand relationship a high standard of performance—that man is the superior surgeon. Before this co-ordination is effected the surgeon seemed but a fledgling but when that time comes almost overnight he becomes an accomplished surgeon whose work reflects confidence in his own performance. Only the surgeon who has trod this steep and winding path can know the cost! Is it worth the effort? Ask any of these men and examine the product critically! Truly there is no royal road to learning.

This circumstance of how quickly the trained surgeon masters operative techniques augurs well for the future of surgery. It suggests how we see further than our predecessors because we stand on their shoulders—in turn our students stand on ours. It is a promising prospect for surgery, the continued growth of which is assured in the hands of the present keen generation of surgeons who are beginning to make their mark. As Leonardo da Vinci remarked: It is a poor pupil who does not surpass his master.

*Motivation of the surgeon* One need not gossip long in the medical sewing-circle, the confessional in which the sins of our neighbors are confessed more adequately than one's own to learn that surgeons are not generally held in that high esteem by our medical colleagues to which we would aspire. There are those who look upon the surgeon as a manual laborer in a Greek dress. There are even those in our own midst who affect to believe there is less science than art in surgery. And many of our medical colleagues who are not as accustomed or as adept as we in employing their hands in the service of their brains are bold to suggest that surgery is only a trade para-

sitie upon the generous gifts of medicine. Take away the petty skills from most surgeons they say and see what empty sacks remain. Are these critics unmindful of the tremendous impetus given greater medicine by the discovery of anesthesia and antiseptics? Have they forgotten how the ministrations of the surgeon make an important contribution to the daily enjoyment of and in many instances to the extension of life?

It seems to me that trained surgeons schooled in the scientific method hold in their hands important tools by which to push back the boundaries of medical ignorance. A disciplined imagination lies at the bottom of every great discovery. The most important requisite of any promising research project is an idea. Surgeons who aspire to make contributions to the patrimony of knowledge would do well to school themselves in the techniques of one of the biological sciences, such as bacteriology, biochemistry, or physiology. I hold strongly to the belief that for the surgeon who aspires to a career in academic surgery that 2 years spent in acquiring the technique of one of these provinces of knowledge will pay usurious dividends not alone to the individual but to surgery and greater medicine as well.

The author of a recent thought-provoking and deservedly popular book<sup>1</sup> writes, "The surgeon's skill sometimes is a splendid example of the sublimation of an early childhood urge to cut. A well known psychiatrist<sup>2</sup> wrote a few years back 'Leaving aside all secondary conscious motives for operating other than those provided by reality we realize that much surgery betrays evidences of being undisguised sadism. I resent such implied or expressed innuendos concerning the motivations of the surgeon. I associate daily with surgeons who give no evidence of such sadistic repressions. If the truth were known the reasons generally are probably far simpler and find their likely explanation in why men become grocers, lawyers, or engineers. You see before you a boy grown to manhood whose consuming ambition was to continue

his activities on the farm that he loved so much. His discerning father suggested that ministering to the physical ills of man would prove even more satisfying than lavishing care on cows, horses and pigs. This was difficult for a growing farm boy to believe. Inasmuch as the spirit of compromise resolves most differences, I suggested veterinary medicine as a substitute. My father far wiser than I continued to insist that medicine was a better outlet, and so I came rather unwillingly into medicine and surgery pushed in through the back door. "Contented industry and the late Wm. J. Mayo, 'is the mainspring of human happiness. And when that labor has to do with making the lot of man more endurable what employment could give greater happiness?' I feel certain that the services of a psychoanalyst need not be enlisted to ferret out the compelling reasons that urged many of you to become surgeons.

It is, however, probably not out of place to suggest that envy, because of the relatively larger incomes earned by surgeons and especially by surgical specialists, lies at the root of much of the criticism directed at surgeons by their medical colleagues. On this score I shall only say that for the years that lie ahead surgeons and other medical specialists paid out of proportion to their contributions to the advancement of medical knowledge, as judged from the critical viewpoint of the true scientist, would do well to consider receiving part of their emolument as increased opportunity. Society rewards us generously for our responsible labors in the relief of suffering and the betterment of man's lot. If however, we value even more the approbation of our colleagues with scientific leanings—a consideration which is not unimportant—some thought might well be lent to utilizing partially the potential earning capacity of surgeons as well as that of other highly paid medical specialists to afford ourselves better conditions of work, thereby improving the product of our labor, and at the same time lending a helpful stimulus to surgery. No doubt, many of you already have resolved this problem in some such manner. Satisfactory conditions of work and an opportunity for creative effort are valued by the thoughtful surgeon as among the best

J. L. Lieberman, *Peace of Mind*, p. 28. New York: Simon Schuster, 1946.

Karl Menninger, *Psychoanal. Quart.*, 13:4, 3, 173.

of paymasters. No one fears that the successful surgeon will starve! The tissues of the rich and the poor patient present the same problem to the surgeon. And the inarticulate but touching gratitude of a patient who can not pay in the coin of our realm, is nonetheless among the best of all rewards of the surgeon.

The surgeon and particularly the older surgeon will do well to contemplate occasionally his motivations and incentives and revalue anew his rewards. Let him also reaffirm periodically the Hippocratic Oath! When long years ago this writer was confirmed in the faith of his fathers the preacher employed on the occasion a text from the prophet Jeremiah: 'Stand ye in the ways and see, and ask for the old paths, where is the good way and walk therein and ye shall find rest for your souls an instruction equally as important for surgeons as well as for Sunday school communicants. Can there be greater rewards than the satisfaction and the peace of mind which come from having served his fellow man well? Our yoke of duty and responsibility may be heavy but whose opportunity and privilege to bring happiness to others is greater?

*The Federated Surgical Society of America*  
The Regents of the American College of Surgeons provisioned the avid curiosity and thirst for new found knowledge on the part of the practicing surgeon, when they instituted the Forum on Fundamental Surgical Problems. The continued interest in this type of program by the general surgeon in practice affords ample demonstration of the wisdom of that decision. And as more of America's best young surgeons who went to war return and manifest renewed zeal to contribute to the advancement of surgical knowledge an even more critical selection of papers for presentation can be assured. The time is now ripe for the formation of the Federated Surgical Society of America embracing all the ancillary surgical specialties much in the manner of the Federated Biological Societies in the preclinical divisions of medicine. That society serves medicine in a unique manner. A similar organization of surgery and its various surgical specialties employing the prototype of the Surgical Forum as its pattern would lend renewed emphasis to the importance of re-

search in surgery. At the same time, it would constitute an important agency in giving better integration to the many now somewhat distinct, branches of surgery. Is not the American College of Surgeons the parent society which should foster this development?

Have surgical meetings had any influence on your intellectual growth and development? They have on mine. Man cannot lift himself up by his bootstraps neither can surgical societies increase surgical knowledge save in so far as they encourage an interchange of ideas between surgeons at the best possible level. Surgical specialists in the same field are not long the best company for one another. There is not enough stimulating sustenance in that type of association for continued growth and development no matter how interesting the interlude provided by such exchanges. The life-giving spirit and vitalizing influence derived from close association with fellow colleagues in the broad domain of medicine is indispensable for the surgeon.

Surgery is on the move. We respect the traditions of the past but the empiricism of surgeons of generations just past is being displaced by the appreciation of and more frequent employment of the scientific method. The touchstone of the scientific method lies in the universal validity of its results. It affords a finality which sets aside all room for continued speculative rationalization. While we are debating and airing our respective opinions on a controversial subject some enterprising individual constructs and carries out the crucial experiment which reveals the truth in the matter. How sterile and unprofitable are discussions based solely on impressions no matter who the authority. Not even the experienced investigator makes a ten strike each time he sets up an experiment. No the progress of research is slow. Yet fact correlated with fact builds a structure which will stand against the winds of time.

It is from the lips of men who are engaged in the exciting pursuit of fact finding that we may expect that stimulating refreshment which makes us better surgeons for the experience. The acquisition of knowledge is not a passive process. List - ing to the recital of the train of events which led up to an im-

portant discovery does not make us better surgeons. It does however make us want to be better and serves to reorient us with reference to the great superiority of the experimental method over empiricism. When all surgeons learn to ask: What is the evidence rather than who employs a certain procedure, then the absorptive capacity of surgeons for new found information will have been enhanced considerably. Surgery will profit immensely by having all surgeons listen to expositions in which the experimental method is employed. Moreover young men prosecuting original researches have a right to be heard. And is it not a bit wearisome to have to listen to parrots of other men's thinking?

*Unnecessary surgery.* Some of my colleagues who are not surgeons tell me that some surgeons perform unnecessary operations and undertake necessary operations which they are not trained to do for pecuniary gain. This is difficult for me to believe. If there be such men in our profession who call themselves surgeons, God have mercy on their souls! Is not the path of the well trained surgeon intent on doing the very best of which he is capable beset with difficulties enough? Can a surgeon take his tasks so lightly that he would submit patients, who seek his counsel to unnecessary or ill advised operations? God forbid! If this be true every man in the profession every hospital in the land should leave no stone unturned to expose such practice. We who enjoy the greatest confidences of patients who place their trust and lives in our hands have a sacred duty to perform. If we knowingly set aside that trust, we are not entitled to the protection which our medical license gives us.

If I forget thee O Jerusalem let my right hand forget her cunning. Steadfastness of purpose and consecrated devotion to his tasks should characterize the resolution of the surgeon in his outlook upon his work.

*Surgery is a stern discipline.* Surgery is an exacting and stern discipline. Let no man who aspires to be a surgeon be unmindful of this admonition. A realistic, critical attitude of self-analysis by the surgeon with reference to accountability for operative failures and postoperative complications is a *sine qua non* for continued growth and development of the

surgeon and betterment of his accomplishment. The irrepressible optimism of the Pollyannish surgeon denies him the improvement and cultivation which comes from a critical review of every failure. At the base of most disappointments lie errors in judgment or execution some neglect that might have been prevented with adequate forethought and preparation. Only when surgeons have succeeded in eliminating all avoidable causes of death after operation can they be satisfied with their own accomplishment—a laudable but unattainable objective. Yet, the struggle of striving to achieve that which lies beyond our reach makes us better surgeons for the effort. Any record, in which only unavoidable deaths account solely for the mortality suggests that the surgeon and his associates have done their work well.

*Improving the surgical mortality score.* A consideration which must be always uppermost in a surgeon's mind is how to reduce the mortality score and at the same time extend the favors of surgery to those patients, who because of age or physical infirmity are not satisfactory operative risks. Familiarity with all the facets of the problem and a studied effort to eliminate or reduce to a minimum all the avoidable causes of death after operation are the items that make for an improved mortality record. In this endeavor the surgeon must exact a high standard of performance from himself as well as from his associates. The day of the one-man operation is over. It takes a trained team of surgeons and nurses, accustomed to working together and alert to the complexities and vagaries of a group of interrelated surgical problems to make a creditable showing. Limitless concern for every detail and precise execution of carefully planned procedures are items out of which success and improvement of the mortality score are compounded.

*Preoccupation of mind of the surgeon.* Because of the very nature of the cares and heavy responsibilities shared by surgeons, they come to have a certain preoccupation of mind. Try as we may it is not easy to disguise completely our feelings when vexed with anxieties over ill patients. Those who know us best seem to be able to divine our true state of mind. The

cares of patients weigh heavily upon the mind of the surgeon and it is understandable that his spirits may exhibit some of the fluctuations of a barometer contingent upon how the patients under his care are getting on. Who among us has not felt a certain buoyancy of spirit when a very ill postoperative patient takes a turn for the better?

*Static character of surgery made dynamic by synthesis of well known facts into new knowledge* This year marks the centenary of the first public demonstration of the employment of anesthesia for operations one of the most beneficial and welcome gifts to mankind in the history of the world. Antisepsis and asepsis recreated surgery and opened up new and undreamed of avenues for the surgeon's skill. The exclusion of infections from clean wounds gave an impetus to surgery and the entire field of medicine such as it has not experienced since. Surgery bounded forward with a terrific surge. Yet after some years, surgery appeared to have reached an impasse such that, surgeons like the late Lord Moynihan were saying again as surgeons of the preanesthetic and preantiseptic era had said that surgery had reached the acme of its development along technical lines. Yet lesser innovations and a better understanding of the derangements in bodily economy attending operation have remade surgery again. The improvements that have come about in the last decade or more are not the startling variety that marked the swift progress which came with anesthesia and asepsis. Nevertheless, real improvement in many areas of surgery is readily discernible. The greatest forward strides probably have been made in intrathoracic surgery. Improved techniques in this province of surgery have permitted performance of operative procedures with low mortality rates for conditions which surgeons looked upon with hopeless discouragement and despair a generation ago. Vascular surgery of the thorax is a new chapter in operations being written by the surgeon of today who has schooled himself in the stern discipline of preparing nice dissections of the large blood vessels of the thorax.

The gauge of a surgeon's accomplishment must be measured against the achievement

for that period. It is unfair to compare the performance of a surgeon of one generation with that of another. There were good surgeons 25 years ago but surgical organization in well appointed hospitals is much better today. Anesthesia is considerably better, our understanding of the nutritional requirements of surgical patients is far better and our knowledge of care of patients before, during and after operation is better. Nursing care also is considerably better than it was a generation ago. We know more about shock and replace blood loss more adequately. We have learned that it takes time and patience to do operations well and that maintenance of a steady state of the patient throughout the operative procedure has done away with the necessity for hurry a circumstance which condemned many an operation to failure although the advocates of the method continued to insist it was the chief determinant in deciding whether a patient would survive.

In other chapters of surgery there has been less conspicuous but nevertheless noticeable improvement. Gastrointestinal surgery has been quite static for a generation. Yet, with similar improvements in technique which gave such accelerated momentum to the surgery of intrathoracic conditions, the last few years also have witnessed the extension of operations upon the gastrointestinal canal to older age groups and substandard risk patients with a constantly declining mortality rate. Apart from the items listed above which played so important a rôle in the flowering of intrathoracic surgery an additional factor which has been of particular significance for the improvement of results in abdominal surgery has been increasing appreciation of the importance of suction applied to duodenal tubes to obviate the occurrence of intestinal distention following operation. Moreover prevention of gastric retention precludes regurgitation into the lungs a former frequent cause of postoperative pneumonia.

The discovery of the sulfonamides and penicillin has lent a great impetus to surgery as it has to medicine as a whole. The discovery of a new fact can change the whole complexion of a problem. But how plodding a process is the discovery of a single new fact!

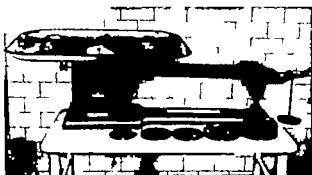


Fig. 1. Weighing scale employed in the general surgical operating rooms at the University of Minnesota Hospitals. Such a scale weighs to an accuracy of 1 gram. The use of dry sponges (save on exposed viscera such as small bowel or lung) serves to inform the surgeon of the blood loss at any juncture of the operation.

Little wonder that a new fact is a priceless possession and that we immortalize the names of men who have added a single important fact to knowledge. Keener appreciation of previously known facts lends its stimulus to a branch of knowledge the impact of a new fact, however gives impetus and momentum that is felt over a tremendous range a new fact is like a ferment in changing a static state into a dynamic one. It breathes new life into an undertaking

#### FORTUNES OF SURGERY

There is no equation or formula which can give a complete answer to the important question of what may be expected of an operation



Fig. 3. Use of the Red-cross litter on platform for patients who can not stand. This scheme of weighing needs the help of nurses and an orderly to lift the patient, with least discomfort to him, onto the litter (Surg. Gyn. Obst., 94 Feb. 2A)

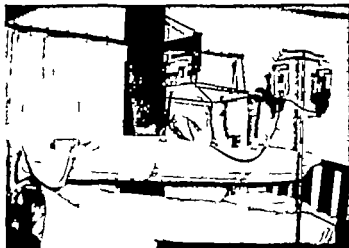


Fig. 2. Patients undergoing difficult operations stand on a bedside weighing scale the day following operation. Patients are weighed in the morning before and rounds, the gain or loss in weight from the prospective weight helps to determine the water and sodium chloride requirements for the next 24 hour period.

The planning of the procedure, the nature of the organization in which the surgeon works, his training and his general outlook on his responsibilities, the character of the diseases he performs, the breadth of his comprehension of what constitutes satisfactory preoperative preparation and postoperative care and the vigilance with which the anesthetist, the surgeon and his staff and the nursing staff watch over the patient—these are the determinants of the outcome of an operation. And yet even in this enumeration some things are left to chance. On this latter score, may I say that the surgeon who leaves the care of a number of items to chance is an unsafe surgeon. No matter how well we have standardized the performance of a certain operative procedure, they are not all performed alike. The hemostasis in one operation may not be as satisfactory as we may have wished it or the somewhat irregular placement of a single suture may have angulated an anastomosis whether gastrointestinal or vascular such as



Fig. 4. a. A new bedside weighing scale built for me by Mr. John A. Phelan of the scientific apparatus shop. This scale, with an electrically driven motor to hoist the patient up and let him down permits weighing the patient in bed.



b. The scale in use. The hoisting device lifts the patient a few inches off the bed. There is no interruption of the administration of intravenously administered fluids.

to affect its function unfavorably. The performance of surgery demands a high level of concentration together with a harmonious co-ordination of eye hand and mind. Perhaps it was this circumstance that Thomas Fuller had in mind when he said the surgeon stands in need of an eagle's eye a lady's hand and a lion's heart. For the difficult surgery of today a sturdy pair of legs is also an indispensable necessity!

*Fatigue undermines the surgeon's efficiency*  
There is no effective antidote for the fatigue and weariness which beset the surgeon in long and strenuous operative ordeals. Intentness of purpose urges him on to the performance of his best effort though it cannot drive away the subjective feeling of fatigue and the physical impairment of efficiency which comes with long sustained application under trying circumstances. There are operations being performed now of such magnitude that the surgeon occasionally stands in greater need of postoperative treatment than the patient on completion of the operation! It is my feeling that an impetus may be lent to the safe conduct of patients through some of the more difficult and tedious operations, when university clinics come to attach greater importance

to some of the techniques employed by industry and football coaches in combatting the inefficiency of fatigue by sending in a fresh team. No surgeon of experience will deny the deterioration of accomplishment which attends fatigue. The interests of the patient which should be the paramount concern in any operation would be served better by such an expedient.

*The great need of more precision techniques*  
Surgery and surgeons generally stand in serious need of greater precision techniques in the gauging of patients as satisfactory risks for operation in the assessment of whether the preoperative preparation is adequate in the intricacies of the operation as well as in post operative management. There is a mortality and morbidity of treatment as well as of disease! Let no surgeon mistake this. We are prone to say the patient died despite all our efforts. How often the converse is true the patient died because of what was done. Are we so blind or dull that we cannot see this? It is in the critical analysis of the events leading to unhappy outcomes that surgeons have the opportunity to improve themselves and to improve surgery.

We can all point out in our own experiences the repercussive effects of ill advised treatment. In this connection I like to tell under graduate students of an experience in which I was in a manner a participant. My family has a summer home not far from the Twin Cities. One of my neighbors is a veterinarian.



One summer before the long war years, we both had young dogs. My good friend the veterinarian said to me his dog had manifested a few signs of distemper and he was in the process of vaccinating him for it. Being a good neighbor he volunteered to do as much for mine. I decided to let my dog take his chances with the distemper. He did contract it and was ill for a week or so but made a complete and satisfactory recovery. A short time following our initial conversation I asked the veterinarian how his dog was getting on. He said he feared he had overdone the vaccination of his dog and in consequence the dog's appetite was poor. As a stimulus to appetite, he was giving the dog some strychnine and the dog was showing signs of improvement. A week later our paths crossed again and I asked the doctor how the dog was getting along. He said that the dog had been overtreated with strychnine causing him to have convulsions. In an effort to control the convulsions, he had anesthetized the dog with ether and had given him too much ether and had killed him! We too are guilty of occasionally shortening lives when we are striving to make them longer and happier. And often that rôle is not as self-evident as it was in this story.

How many patients lose their lives each year because of mismanagement of the water and electrolyte requirement of patients? To say many is an understatement. Is it happening in your clinic? It has in ours. I believe that when surgeons generally become more alert to the factors of safety in this intricate problem they will have taken an important step forward in improving their own accomplishments. I shall not say very much about our general plan of management of this problem here for I have discussed the problem at length elsewhere (2, 3, 4). I have the feeling however that when surgeons lend a more attentive ear to assessing such needs of patients in a more quantitative manner they will be agreeably surprised to observe what great help such guides afford them.

Routine use of dry sponges in operations affords an opportunity to assess the gain in weight, thus informing the surgeon of the extent of the blood loss at any juncture of the

procedure. To replace fluids in kind and in amount with that lost is obviously the best treatment. And to weigh patients before and immediately after operation, as well as in the convalescent period is the best of all guides in helping the surgeon orient himself with reference to the electrolyte and fluid requirements of his patient. Moreover the weighing scale is far more sensitive in the detection of minor changes in body hydration than are changes in hemoglobin. Obviously such routine weighing of patients undergoing major surgery is often unnecessary for the problem of hydration seems to resolve itself by employment of simpler means involving less trouble constituting therefore needless effort. But who counts the cost of labor when lives are at stake? Do we not read almost daily in the newspapers of the heroic sacrifices of men with no view to cost or personal danger, assuming large risks in the effort to save a life? In the hospital in which you work have lives not been lost because the surgeon and his staff were not alert to the changes occurring in hydration and electrolyte balance of the patients? We have lost patients needlessly through this agency while professing an interest in the problem of water and electrolyte requirements of postoperative patients, at the same time, enlisting the helpful co-operation of the best talent that a University Clinic has to offer in the solution of such problems. It is in just such situations that the weighing scale has its chief virtue, in affording a preview of what will happen if abnormal contractions or increases in body weight continue uncorrected. This I may also say: since the expedient of weighing patients undergoing major surgery has become routine practice on the writer's surgical service, loss of life through disorientation of the surgical staff with reference to the important problem of hydration of patients has been more than decimated. I must confess we still go astray occasionally but usually recognize the error in our ways before disaster overtakes us. It is in the surgery of elderly substandard risk patients, who tolerate abuses poorly and especially in the surgery of gastrointestinal conditions necessitating the presence of hiatal duodenal tubes, that the weighing scale is a

*sine qua non* if the surgeon aspires to do such operations with risks not far out of line with those assumed by younger standard risk patients. Reducing the mortality score as I stated previously consists essentially in the recognition of error and its correction. If a patient's weight in the early postoperative phase can be maintained within 2 to 3 per cent of the preoperative value (plus or minus) the surgeon is assured that the water and electrolyte requirements of his patient are being met satisfactorily. Pneumonia and cardiac failure as a consequence of overhydration owing largely to the administration of too much sodium chloride we saw not infrequently postoperatively among older patients undergoing extensive and complicated surgery before routine employment of the weighing scale. Routine weighing of such patients to detect deviations from the preoperative normal is at least as important as taking the patient's temperature. When surgeons learn to deal satisfactorily with the difficult problem of hydration of postoperative surgical patients, one of the most formidable of hazards to safe conduct of the patient through operation will have been surmounted. It is a barrier to recovery from operation that the surgeon must learn to hurdle.

Mr Albert Sullivan Jr.<sup>1</sup> in studying the case records of 151 consecutive patients undergoing major surgery upon the gastrointestinal canal, during the first 6 months of 1946 observed that in this group slight losses of weight were far more common than gains in weight. Only 11 patients (7.3 per cent) showed a weight gain of 2.5 per cent of their total body weight, whereas 76.8 per cent exhibited weight losses of 2.5 per cent or more. The greater number of this group lost weight during the first 5 days after operation. Only 1 patient lost more than 6 per cent of the body weight. The average age in this group of patients was 58.9 years. These findings suggest that our surgical staff is more sensitive to weight gains than losses in weight. All of the patients in this group had intelying duodenal tubes, presenting therefore essentially the most difficult problems of maintenance of

water and electrolyte equilibrium. Obviously the cause of the weight loss in most instances was administration of too little sodium chloride accompanied by employment of moderately generous quantities of 10 per cent glucose solution. The effect of such therapy is to promote diuresis a circumstance that is pleasing to surgeons especially when dealing with a group of patients whose mean age is high. Needless to say it is important to take careful note of small deviations from the preoperative weight in order to keep fluctuations in weight at a minimum. Of the total measurable output of body fluid 70 per cent was urine the remainder being constituted largely by the fluid aspirated by the intelying duodenal tube. The average daily administration of sodium chloride was 6.5 grams in the early convalescence of those patients losing 2.5 per cent or more of their body weight. These observations suggest that the daily administration of 6.5 grams of sodium chloride is probably slightly less than enough for patients with intelying duodenal tubes undergoing major surgery upon the gastrointestinal canal.

Acquaintance with and employment of precision techniques by the surgeon and his staff in the various items that hedge about an operation afford the patient the best promise of a favorable outcome. It is the operation without mishap and a convalescence without complication that spells success. Such a procedure also permits early ambulation and early dismissal from the hospital. The convalescence punctuated by complication is synonymous with increased morbidity as well as mortality. The circumstances which characterize success and failure are often 'minor differences' but it is out of infinite and alert attention to detail that success is compounded. By very dint of factors that constitute the "minor differences" between success and failure the surgeon can gradually overcome the hazards that are undermining his efforts. Recognition of error when accompanied by a resolute determination shared by the surgeon's staff to avoid the repetition of such mistakes, is the best assurance against failure. It is a source of ever recurring wonder to me how well patients get on after serious operations un

<sup>1</sup>Medical student from Tulane, doing a voluntary externship on the surgical wards during the summer of 1946.

attended by complication. And when surgeons succeed in making the unpleasant trials of the waking and recovery periods following operation more agreeable, patients will be less likely to regard an operation as a journey through the valley of the shadow of death.'

#### SUMMARY AND CONCLUSIONS

Order is heaven's first law. It also must rank among the most important of guiding principles in the surgeon's code. Without order the results of operation are unpredictable. A surgeon who has regulated his activity in accord with semblance of good order comes well prepared for operation. Preparation has to do with readiness as well as fitness. He does not undertake operations for which he is not prepared. Nor does he perform unnecessary operations. The surgeon's trust is as sacred as life itself and must not be profaned. The surgeon who has schooled himself in the preparation of nice and precise anatomical dissections does not permit himself to be hurried. He places the safety of his patient above every other consideration. And the security of the patient demands not alone that, the surgeon watch over him with tender and observant care during operation but that the surgeon has seen to it that no detail is overlooked in the preoperative preparation, and that alertness and vigilance characterize the care of the patient after operation.

The success of operations depends upon a harmonious blend of many things. The practical wisdom garnered from experience is in

essence an issue resulting from detection, acknowledgment, and correction of error. Though we falter if we are in earnest in our determination not to fail, success is inevitable. We must learn to count the cost less and value the result more. The surgeon's objective should be the elimination of all avoidable causes of death after operation. The safe conduct of the patient through operation is a matter upon which an instruction can be given more readily than consistently followed. Portia's prudent counsel in the *Merchant of Venice* on this score is well known to you. She said, "If to do were as easy as to know what were good to do, chapels had been churches and poor men's cottages princes' palaces. It is a good thing that follows his own instructions. I can easily teach twenty what were good to be done than be one of the twenty to follow mine own teaching. The fortunes of our patients are determined by the manner in which the formalities of surgery are heeded by the surgeon. The functions of surgery and its future growth as a benevolent and helpful aid to man suggest that improvement in accomplishment demands that the surgeon be mindful and observant of the stern disciplines of his handicraft.

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# CLINICAL USES OF STREPTOMYCIN IN MEDICINE AND SURGERY

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**A**LTHOUGH streptomycin was first described by Schatz, Bugie and Waksman less than 3 years ago the drug is already in full commercial production and distribution and has proved to be a useful antibacterial agent in medical and surgical practice. The full possibilities and limitations of streptomycin treatment in several important diseases remain to be determined but progress has been extremely rapid in the last 2 years and should continue at an accelerated rate.

The usefulness of streptomycin is dependent on the fact that this antibiotic agent is effective against several pathogenic bacteria which are not susceptible to the action of other antibacterial substances. These bacteria include some frequently encountered gram negative bacilli and above all the bacillus of tuberculosis.

The treatment of infections of the urinary tract due to bacteria sensitive to streptomycin has been extensively studied (7-9) and it is uniformly agreed that streptomycin is of value in such treatment although its potentialities are limited. These bacteria frequently acquire a resistance to the action of streptomycin within a few days hence if permanent results are to be realized, it is extremely important that conditions favorable to persistence or recurrence of infection be corrected promptly if possible. Strains resistant to streptomycin are more likely to be developed if there is obstruction to flow of urine or if calculi or other anatomic defects permitting survival of bacteria are present. The importance of proper timing of treatment in relation to surgical intervention becomes obvious.

Bacteremia due to gram negative bacilli sometimes occurs, especially in association with severe infections of the urinary tract and

as a postoperative complication following operation on the infected urinary tract. Streptomycin therapy frequently is effective in treatment of such bacteremia (7-9) when due to organisms sensitive to this antibiotic agent (9).

Meningitis due to sensitive micro-organisms especially gram negative bacilli should be treated with streptomycin utilizing both parenteral and intrathecal routes of administration. My associates and others (7-9, 10) have reported favorable results in influenza meningitis treated with streptomycin.

Since acute peritonitis is frequently of such serious portent and due to such an admixture of pathogenic micro-organisms I would recommend the simultaneous use of all available antibacterial agents in medical treatment. The combination of streptomycin with penicillin appears to be thoroughly logical under these circumstances, especially if the peritoneal cavity is soiled with intestinal contents.

Wound infections due to mixed bacterial flora should frequently be treated with both penicillin and streptomycin especially if bacteriologic examination proves the presence of sensitive micro-organisms. Fully adequate débridement should first be carried out to minimize the possibility of a recurrence of the infection due to bacteria which have acquired a resistance to the action of streptomycin.

Streptomycin is of real value in some cases of chronic suppurative pulmonary disease such as bronchiectasis (11) and especially as a preoperative measure preparatory to pulmonary resection. Here again it should usually be used in conjunction with penicillin and administered as an aerosol. The duration of treatment will vary from 1 to 2 weeks or more the treatment being continued until sputum is reduced in amount, changed in character and rendered bacteriologically sterile or nearly so. Cases of bronchiectasis suitable for streptomycin therapy may be selected by merely ex-

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aming smears of the sputum stained by Gram's method. If numerous gram-negative bacilli are present, streptomycin is likely to be a useful adjuvant to penicillin therapy.

Acute and chronic infections of the respiratory tract due to organisms of the *Hemophilus* and *Klebsiella* groups may be treated successfully with streptomycin (7-9).

The treatment of tularemia with streptomycin has yielded spectacular and promptly curative results (5). Streptomycin may be considered a specific remedy for tularemia; hence the accurate diagnosis of tularemia becomes of greatly increased importance.

Brucellosis and typhoid fever are caused by organisms which are only moderately sensitive to streptomycin. The latest available reports of streptomycin therapy in these diseases are not encouraging (9) except possibly during the most acute phases with demonstrable bacteremia.

When streptomycin is administered orally it is not absorbed from the alimentary tract in significant amounts; hence its oral administration is useless for treatment of systemic infections. However the antibiotic agent is not destroyed but remains within the lumen of the bowel to exert its antibacterial effect on the intestinal flora (6). The possibilities of orally administered streptomycin have not been fully studied for preoperative preparation of patients prior to intestinal operation, either as a substitute for sulfonamides or in combination with sulfonamides. My surgical colleagues have made sufficient use of streptomycin in this manner to indicate that it does have practical possibilities.

The action of streptomycin on cultures of *Mycobacterium tuberculosis* was noted early (13) but this is a property which had been described previously for a number of other substances of microbial origin (4) and many synthetic chemical compounds (14). When streptomycin proved to be extremely effective against experimental tuberculosis of guinea pigs (2-3) its clinical possibilities were recognized and quickly explored.

The greatest potentialities for streptomycin therapy appear to exist in treatment of tuberculosis (8) including some surgical types of tuberculous infection. This is due to the fact

that no other practical and effective antibacterial therapy is available against the bacilli of tuberculosis and to the fact that this bacillus is much more sensitive to streptomycin than are the other common pathogenic bacteria. Furthermore the tubercle bacillus remains sensitive to streptomycin for at least a few months before becoming drug resistant (15) and this permits realization of satisfactory therapeutic effects, especially in lesions of recent origin. It also has been found that some rather poor candidates for radical surgical treatment of pulmonary tuberculosis may be rendered excellent candidates after a few months of treatment with streptomycin. Likewise postoperative tuberculous complications may be amenable to streptomycin therapy or may be prevented by use of the drug.

Many types of tuberculous infection unfortunately produce destructive changes which no drug can directly benefit. Antibacterial therapy is only suppressive in this and other diseases and will yield permanent benefits only if natural mechanisms of healing can achieve supremacy during the limited period of a few months during which the bacilli are sensitive to the action of streptomycin. Selection of tuberculous patients for streptomycin treatment must be undertaken with the greatest care. During the past 2 years my colleagues and I have followed a few simple rules, based on our concept of the action of streptomycin. These rules may be enumerated as follows: (1) Patients who are making satisfactory progress on conventional forms of treatment for pulmonary tuberculosis or who are likely to do so should not receive streptomycin. (2) Patients who have terminal types of pulmonary tuberculosis, especially when bilateral destructive changes are present, and who could not become candidates for surgical treatment are not regarded as good subjects for streptomycin treatment. (3) Patients who have old chronic nonprogressive fibrocavous and cavernous types of pulmonary tuberculosis are not likely to experience satisfactory results and hence should not be treated. (4) Priority in treatment has been given to more acute, progressive pulmonary tuberculosis of recent origin. In general, patients with most severe constitutional symptoms and with least destructive

pulmonary changes have obtained the best results from streptomycin treatment. These are individuals with naturally low resistance or with depleted resistance, and hence those most in need of assistance from antibacterial therapy. It should be repeated that such treatment should be given before the disease has wrought changes in the lung such as cannot be repaired within a few months. All patients with pulmonary tuberculosis chosen for streptomycin treatment should have a component of exudative disease and the larger the proportion of exudative to proliferative tubercles the better.

The clinical results of treatment of such patients often are realized promptly. Within the first few weeks fever declines, cough and expectoration decrease, appetite and a sense of well being return and the patient begins to regain lost weight. Later after 6 to 8 weeks of treatment, roentgenographic evidences of improvement of exudative lesions are first noted. Usually within 3 to 5 months maximal clinical and roentgenographic improvement has been attained. This would appear to be the time for surgical treatment of remaining disease and especially for closure of any remaining cavities, such as might serve as sources for subsequent bronchogenic dissemination of the disease.

Ulcerating tuberculous lesions of the larynx, the hypopharynx and the tracheobronchial tree have healed rapidly and so far without exception in our small series of 10 cases. These patients have received combined treatment with intramuscularly administered streptomycin and streptomycin aerosol.

Some types of extrapulmonary tuberculosis have responded to streptomycin treatment with remarkable uniformity. This is especially true of chronic long standing draining sinus tracts, which usually close within a few weeks, but these will remain closed only if treatment is continued for several weeks after apparent healing. In renal tuberculosis and tuberculous cystitis temporary and palliative effects have been observed frequently but actual healing of renal lesions has been observed rarely possibly because the kidney lacks the power to heal tuberculous readily. In only a few cases of tuberculosis of bones and joints has strepto-

mycin been used but results have been encouraging. Much remains to be learned about streptomycin in relation to orthopedic surgery in the treatment of tuberculosis of the skeletal system.

Until the advent of streptomycin there was no way in which the course of tuberculous meningitis and miliary tuberculosis could be modified. Even with streptomycin treatment there is an extremely high mortality rate. However in most cases of early tuberculous meningitis the patients respond promptly to adequate intramuscular and intrathecal streptomycin treatment but all too frequently these gains are not permanently sustained. At least temporary clinical remission is almost the rule following streptomycin treatment of early but acute and severe tuberculous meningitis. Consciousness is regained often within a few days fever declines within a few weeks a sense of well being returns and frequently patients appear to be essentially normal, even for several months. Subsequent exacerbations of the disease are likely to recur and not to respond to treatment. However this may not always be true for in 3 cases of proved tuberculous meningitis arrest of the disease continued for several months following discontinuation of a 6-month course of intensive treatment. One patient has no residual neurologic signs, one is normal except for deafness and the third has apparently received severe damage to the central nervous system, especially the cerebellum. Although nearly a year has passed since the onset of illness in these 3 cases it is too early to classify the patients as cured. Five patients who had tuberculous meningitis have died despite treatment but 3 of these did not receive what is now regarded as adequate treatment and the remaining two were first seen at a late stage of the disease.

Disseminated hematogenous tuberculosis of miliary type has not responded previously to any form of treatment and spontaneous recoveries have been extremely rare. With streptomycin treatment it is possible to bring about a complete clinical and roentgenographic remission in a large proportion of cases but unfortunately the recurrence rate has been very high thus far and three of our four treated patients have eventually died. The remaining

patient has remained well for 6 months but cannot yet be classified as cured.

Tuberculosis of the alimentary tract and tuberculous peritonitis have not been studied adequately but symptomatic improvement of the 5 patients who have been treated at the Mayo Clinic has been striking.

Although clinical effectiveness of streptomycin is readily demonstrated in many types of tuberculous infection the results are often not permanent and frequently do not compare with results achieved in acute diseases treated with other antibacterial agents such as penicillin. The limitations of streptomycin treatment in tuberculosis must be emphasized constantly in this day of "miracle drugs" and the emphasis must still be placed on the known effective methods of treating tuberculosis, especially care in a sanatorium and collapse therapy. The place of streptomycin in tuberculosis therapy has not been determined but this agent is much more likely to supplement than to supplant the proved effective standard methods of treatment.

Streptomycin usually is administered by intramuscular injection doses being given every 3 to 4 hours and totaling from 1 to 3 grams per day. The lower limits of effective dosage have not been fully explored nor can final statements be made concerning the upper limits of safe dosage. Streptomycin is more toxic than penicillin but very little difficulty is experienced in treatment of more acute diseases which require only a week or two of treatment. When treatment is continued beyond 2 to 4 weeks nearly all patients will experience some disturbance of equilibrium (1) occasionally to a severe degree. Fortunately compensation is achieved in all or nearly all instances more promptly in younger than in older patients and no permanent disability is likely to result. Sluggish response to caloric stimulation of the vestibular apparatus is usually noted for many months and perhaps permanently even when there is no residual functional disability. The cause and significance of these changes have not been determined fully and are in need of complete investigation. Deafness has been noted occasionally but hearing is ordinarily regained if treatment is discontinued promptly. In this respect, strep-

tomycin resembles such drugs as quinine and salicylates. Evidence of renal irritation has been noted occasionally but serious renal damage is not nearly so likely to occur as it is with administration of sulfadiazine. Streptomycin should be used with caution when there is reason to fear pre-existing impaired renal function because the drug may not be readily excreted under these conditions.

#### SUMMARY

Streptomycin is an effective antibacterial remedy of value in treatment of several infectious diseases not amenable to treatment with other antibacterial substances.

Streptomycin may be used in combination with penicillin for treatment of mixed infections such as are likely to occur in the presence of acute peritonitis, chronic suppurative pulmonary disease and contaminated wounds.

Streptomycin has value in treatment of infections due to gram-negative bacteria occurring in the blood stream, in the meninges, or in the urinary tract.

Streptomycin is highly specific in treatment of tularemia. It has but little value in treatment of brucellosis and typhoid fever.

Streptomycin is the only practical antitubercular substance which is useful in treatment of tuberculosis. Limitations of streptomycin therapy in this disease appear to be imposed by the destructive and granulomatous changes produced in tuberculous tissue and by the fact that the drug cannot be depended on to destroy tubercle bacilli in the human body.

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## THIOURACIL AND IODINE

### The Preoperative Management of the Thyrotoxic Patient

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FROM the reported experiences in the collected literature, 3 salient characteristics of thiouracil therapy have been emphasized. These have been the prompt clinical response to the drug, the standardization of the dosage at 0.6 gram, daily by which the basal metabolic rate is reduced 1 per cent each day and most important, that thiouracil toxicity has appeared in about 14 per cent of all patients so treated. Since so much value yet so much danger has been found in the treatment of the thyrotoxic patient with thiouracil, some safer method of management should be sought to obtain the maximal therapeutic effect of the drug with the greatest margin of safety. This has been the objective of the present study: an admittedly small series since from a total experience of 527 thyroidectomies only 20 recent hospital cases were considered suitable for this form of therapy.

There were 16 females and 4 males varying in age from 23 to 76 years. The average age of 45.1 years was equivalent to that of 190 thiouracil treated patients reported by Lahey. In the series were 9 nodular and 9 diffuse goiters and 1 recurrent goiter in each group. The tissue submitted from the recurrent diffuse goiter was reported by the pathologist as adenocarcinoma. All admission basal met-

abolic tests were made after at least one day of rest in bed. The highest was plus 72.4 per cent and the lowest plus 25.1 per cent. The average plus 43.57 per cent. This approximated Lahey's average of plus 49 per cent. Admission leucocyte counts ranged from 10,050 to 41,500 with an average of 7,135. All other clinical laboratory determinations and radiological examinations were performed routinely on admission but have been omitted from this report. Medication was withheld until the laboratory findings were charted. Bed rest except for 2 hours daily was the rule. In addition ice caps were applied to the head and precordium intravenous fluids were administered as indicated and sedation obtained by the generous use of phenobarbital. The average daily dose of phenobarbital was 4 grains. This included the larger doses of 3 grains to 9 grains given the night before operation. While the Bartlett's have advocated larger amounts to produce narcosis and semi-anesthesia these patients were easily managed on the smaller dosages since avertin was used as a basal anesthetic 45 minutes before the scheduled operating time. All patients received 0.6 gram of thiouracil daily divided into 3 doses each of 0.2 gram. The longest period of administration was 21 days the shortest 6 days and the average 11.9 days. There were 4 exceptions to this dosage. In 3 patients it was necessary to increase the amount and in 1 to decrease it. In Case 8 patient previously iodine resistant, required 0.6 gram daily for 8 days 0.8

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62 days Thyroidectomy was performed without incident and without postoperative storm in all cases. In Case 5 a large nodular intrathoracic goiter in a patient aged 65, the admission basal rate was plus 31.3 per cent and grave myocardial damage without heart failure was present. The rate was reduced to plus 14.2 per cent by thiouracil and patient was then iodinated. Death occurred less than 30 minutes after the incision was made as the right lobe and isthmus were removed. This was a cardiac death in the thyrocardiac group which is known to carry the highest mortality rate.

Since end results and the time spent in a hospital have always been pertinent factors this form of management should be compared with present methods of combined ambulatory and hospital care. Thiouracil was used an average of 11.9 days plus Lugol's solution 6.2 days or a total preoperative time of 18.1 days. Case 5, the operative death and Case 20 in which patient refused operation have been deducted from these figures. The average postoperative time was 6.8 days or an average total hospitalization of 24.9 days. During all of this time each patient was under medical control while receiving a known toxic drug. This control cannot be exercised over outpatients having at their personal disposal 1 or 2 weeks' supply of thiouracil. Until thyroid disease can be cured medically, the thyrotoxic patient must eventually come to operation. While the standard 0.6 gram daily dose of thiouracil effectively reduced the basal metabolic rate this small series of 527 thyroidectomies and the thousands re-

ported elsewhere have clearly pointed out that Lugol's solution, bed rest and sedation as well as thiouracil are still factors essential to the successful management of the thyrotoxic patient.

#### SUMMARY AND CONCLUSIONS

1 Thiouracil has a field of usefulness and should be limited to the preoperative preparation of the thyrotoxic patient.

2 The dangers which have been previously reported appear to be due to the prolonged use of a potent drug.

3 These dangers can be minimized in the hospital by careful observation, study and the individualizing of treatment to the needs of each patient.

4 It would seem unwise to place in the hands of an out patient a dangerous drug and allow such a patient to be removed from regular and controlled observation.

5 The use of iodine in conjunction with thiouracil is a sound and safe practice since it eliminates uncontrollable operative hemorrhage and thus ensures safe hemostasis.

6 Reduction of the basal metabolic rate to limits between plus 15 per cent and plus 30 per cent by thiouracil followed by the administration of large doses of iodine reduces the preoperative preparation time to the economic advantage of the patient without materially increasing the surgical risk.

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TABLE II.—CLASSIFICATION OF CLINICAL DISORDERS OF FLUID AND ELECTROLYTE BALANCE\*

Water disequilibria	Salt disequilibria
1. Acute water deficit.	1. Extracellular salt water deficit.
2. Chronic water deficit.	2. Extracellular salt water deficit with water deficit.
3. Absolute water excess.	3. Extracellular salt water deficit with relative water excess.
	4. Extracellular salt water excess.
	5. Extracellular salt water excess with relative water deficit.
	6. Extracellular salt water distributional shifts.
	7. Any of above (1, 2, 3, 4, 5, 6) with changes in base-bicarbonate (alkalosis or acidosis)

\*Intracellular salt disequilibrium states are not considered in constructing this table.

gresses at a rate rapid enough to prevent the kidney from excreting salt in sufficient amounts to maintain the solute concentration of the body fluids at a normal level. This state is accompanied by intense thirst if the individual is conscious. The clinical signs that accompany acute water deficit are oliguria, dryness of mucous membranes, elevation of body temperature (rectal), and hallucinations, disorientation mania, and coma in order of progression of the deficit. The laboratory signs are a high urine specific gravity (if renal function is good) high blood urea, and concentration of red blood cells plasma proteins, chloride and sodium in the blood.<sup>1</sup> The correlatives necessary for making the diagnosis are the physical signs of water deficit, a high urine specific gravity and the absence of signs of an extracellular salt water volume deficit (see extracellular salt water volume deficit)

**Chronic water deficit.** (Primary water deficit with a normal solute concentration of body fluids, Fig. 2.) Chronic water deficit is the most frequently encountered disturbance of fluid equilibrium in psychiatric institutions. It differs from acute water deficit because a compensatory renal excretion of salts (Na and

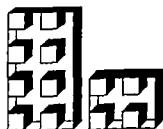


Fig. 2 At left, normal extracellular fluid at right, chronic water deficit.

K) occurs as the body content of water falls (4). This tends to maintain the solute concentration of body fluids within normal limits. However, salt concentrations finally rise when the deficit of water becomes so great that in sufficient water is provided to the kidney to excrete the salt necessary to keep solute concentrations normal.

In the treatment of chronic water deficit one must remember that salt deficit is associated with the water deficit even though no obvious loss of salt by vomiting, diarrhea, or sweating has occurred.

The cause of chronic water deficit is a decrease in the rate of water accretion of such a degree that the rate of total water gain is less than the rate of minimal water loss. However, the discrepancy between the gain and the loss of water is not so great as to prevent the kidney from holding the solute concentrations of body fluids within the ranges compatible with health.

The most frequent cause of the disorder is a reduction in the sensorium that under conditions of health keeps the water content of the body within a relatively narrow range of variation. Its frequency of occurrence is high in psychopathic states organic brain disease (senile alcoholic, luetic, postapoplectic), drug addiction, chronic febrile illnesses, geographic limitation of water intake, and chronic painful states (peripheral vascular disease causalgia, chronic infection, arthritis and neoplasia).

The clinical signs of chronic water deficit are predominantly those of an extracellular salt water (base) deficit provided that the development of the deficit proceeds slowly enough for the kidney to keep the solute concentration of the body fluids constant. However the signs of acute water deficit may be added to those of extracellular salt water defi-

<sup>1</sup>N is especially that diminished elasticity of the skin, softening of the eyeballs, and longitudinal wrinkling of the tongue are not listed as signs of acute water deficit.



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erally associated with states of water deficit or excess, or states of alkalosis or acidosis. A continued excretion of sodium in excess of that taken into the body is its cause. The excretion may be extrarenal (vomiting, diarrhea, fistulae) or renal. The renal excretion may be compensatory as in chronic water deficit or pathologic as in renal tubular hypofunction (hydro-nephrotic atrophy). The associated presence of water equilibrium disturbances will depend upon the concomitant rate of water accretion. If less water is drunk during the development of the extracellular salt water deficit than was lost through kidney, skin and lung, an associated deficit will be present. The development of changes in composition, alkalosis or acidosis, are mainly dependent upon the composition of the fluid lost from the body. Polyuric obstruction with vomiting of an acid solution tends to be associated with an alkalosis. Loss of pancreatic juice, an alkaline solution (pancreatic fistula), produces acidosis.

The signs and symptoms of an extracellular salt water deficit are variable. They depend in part upon the rate of formation of the deficit, in part upon the water content of the body other than that in the extracellular fluid, upon the concomitant rate of potassium loss, and upon the degree of the "uncompensated" compositional changes that may be associated with the deficit. The signs and symptoms of a relatively uncomplicated deficit are as follows:

1. Usually there are no definite signs or symptoms associated with a salt water deficit of 0 to 2 per cent B in a healthy adult.<sup>3</sup> However, in the aged in winter and in the chronically ill, a reduction of the extracellular salt water volume of this degree may be attended by severe symptoms and signs.

2. An extracellular salt water volume decrease of 2 to 4 per cent<sup>3</sup> B is accompanied by apathy, weakness, somnolence, anorexia, brief periods of nausea, reduced affective responses,<sup>3</sup> transient vertigo on assuming the erect posture, a soft pulse with insignificant

and variable changes in systolic blood pressure and pulse rate, and a slightly sticky skin. This stage has been called the "early barbituric acid-depressive phase of salt deficiency."

3. An extracellular salt water volume decrease of 4 to 6 per cent B ( $1/3$  to  $1/2$ ) of the extracellular fluid volume is associated with an increase in severity of the above signs and symptoms and in addition occasional unproductive retching, syncope on attempting to stand, a lowered blood pressure—frequently to "shock" levels, a variable pulse rate—usually tachycardia, a subnormal temperature if ambient temperature is below 85°F,<sup>3</sup> a wrinkled tongue, sticky skin, "putty" muscles, and soft eyeballs.

4. Coma finally supervenes and death occurs with reductions of  $1/2$  to  $3/4$  of the "normal" water volume of  $1/2$  to  $3/4$  of the "normal."

The laboratory signs are variable and are in part dependent upon the amount of the deficit (little change of solute concentration with small deficits regardless of rate of water ingestion) (11) upon the composition of the salt solution excreted (plasma chloride falls faster if stomach contents are lost than if small bowel contents are) upon the rate of water accretion in deficits of salt water volume greater than 2 to 3 per cent B (see chronic water deficit and extracellular salt water deficit with "relative water excess") and upon the rate of development of the deficit.

The finding of "normal" blood solute or red blood cell concentrations does not rule out the presence of an extracellular salt deficit. However, a diminution of the solute concentration (Na and Cl) with an increase in the concentration of red blood cells (high hematocrit) is positive evidence that a relatively severe and rapidly developed extracellular salt water deficit exists. The relationship of the changes in solute and red blood cell concentrations to the salt water deficit are qualitative but usually not quantitative. Therefore the history and the physical examination constitute the best bases for ascertainment of the existence of salt water deficit.

B<sub>0</sub>—original body weight.

<sup>3</sup>When extracellular salt water volume deficits are associated with a proportionately greater water deficit, when they are very great and the individual is near death, when it occurs in infancy or when it is incurred in hot climates, an elevated temperature is usually found.

The more rapidly the deficit develops, the more severe are the symptoms and signs that accompany a given deficit.

Author's observations on C.A.M. Three trials, fasting state for 14 hours, volume deficit induced by continuous duodenal drainage for 50 hours excepting for eight 14-hour periods with the tube clamped to permit the drinking of water to allay severe thirst.

<sup>3</sup>No desire to smoke, read the paper or talk to anyone.



Theoretically the actual water content of the body in this state, although it is usually in deficit, may actually be in excess of the individual's usual content in health even though extracellular fluid volume is below normal in spite of its dilution with water. To have this particular condition readily obtain it is necessary that the loss of extracellular sodium proceed without much reduction of intracellular base and with a rate of water accretion that is faster than its rate of loss.

A full blown picture of an extracellular salt water deficit with water intoxication does not occur often with environmental temperatures below 85 degrees F. However, at low environmental temperatures it may complicate the course of recovery from trauma (operative, 20 thermal 22, crush) provided that too much water is given too soon or that too little sodium is given too late. The rate of excretion of positive loads of water by the kidney is reduced and may approach zero with severe salt water deficits. In oliguric or anuric states associated with an extracellular salt water deficit, the restoration of the solute volume and the concentration of the extracellular fluids by the administration of an appropriate interstitial salt solution is of primary importance in the re-establishment of kidney function. If an attempt be made to force urine flow by the administration of water before the extracellular fluid volume deficit is corrected, severe water intoxication may be induced, and an oliguria converted to anuria.

Extracellular salt water deficit with water excess (miner's cramps) occurs fairly frequently in hot environments if a sodium deficit is incurred while the drinking or the administration of water is not limited (21). Heavy work by an untrained, unacclimatized person (high rate of Na loss through sweating) and a reduction of sodium intake below minimal rate of loss in a person at rest (alcoholism, febrile illnesses, etc.) are the usual immediate causes of the sodium deficit.

through fistulous tracts (duodenal, choledochal, pancreatic and enteric); with the chronic loss of extracellular fluid from granulating wounds; and with limitation to details in the care of people with large wounds (placing individuals with large open wounds or granulating surfaces in tubs of water rather than on linen, the covering of large wounds with wet dressings that are wet with water or hypotonic salt solutions as boric acid).

The physical signs and symptoms of an extracellular salt water deficit with relative water excess are those of an extracellular salt water deficit, those of an absolute water excess, and those of uncompensated compositional changes if they are present. Obviously large individual variations in signs and symptoms will be present. The laboratory signs of an extracellular salt water deficit with relative water excess are as follows: a low sum of the plasma chloride and bicarbonate (below 115 to 120 mEq per liter) in the absence of acetoneuria, a low urine chloride concentration and a normal or an increased concentration of red blood cells. These are the most essential correlates to be considered in formulating a diagnosis of an extracellular salt water deficit with relative water excess.

*Extracellular salt water excess* (Fig. 7) The symptoms and signs of a rapidly induced relatively small excess are listed in Table III. The sensible loads at the end of the period of loading varied from 2.8 to 4.1 percent of body weight because of the excretion of the salt water (renal and intestinal) that occurred during the loading period. The volume of

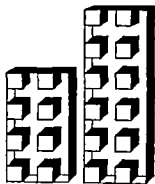


Fig. 7. At left, normal extracellular fluid; at right, extracellular salt water excess.

fluid given always amounted to 5 per cent body weight in 5 hours.

The signs and symptoms vary and seem to be partially dependent upon the composition and toxicity of the solution that was administered, especially by the oral route. Haldane and Priestley described this relationship earlier. The salt solution drunk "was meant to approximate to the salt content of human serum and was found to be much more palatable than 6 p.c. sodium chloride solution—a point of some practical importance because it



TABLE III.—SYMPTOMS AND SIGNS OF EXTRA-CELLULAR SALT WATER EXCESS IN MAN

Symptoms	Group			
			3	4
Chilly sensations	100%	100%	0%	40%
Nausea	100	80		0
Hoarseness	100	100	100	100
Abdominal cramps	83	80		
Lethargy	66	40	100	40
Heavy eyelids	77	100	00	100
Headache	44			
Soreness	44	0	80	
Thirst	66	100	00	
Stress Personality changes (Irritability or depression)	77		40	0
Massive repeated watery stools	66			
Mildness edema of legs	44	60	80	
Mildness edema of hands and legs	11	20	80	
Muscle incoordination	44		60	0
Dyspnea with mild exertion			80	
Ventilation				

Group. Nice healthy fasting men, loaded with 5 per cent  $B_u$  of .85 per cent NaCl solution at rate of per cent  $B_u$  per hour by mouth.

Group. Five healthy fasting men, loaded with 5 per cent  $B_u$  of 0.85 per cent interstitial salt solution (NaCl, 24 mEq. per liter plus  $NaHCO_3$ , 30 mEq. per liter in water) at rate of per cent  $B_u$  per hour by mouth.

Group 3. Five healthy fasting men, loaded intravenously with 5 per cent  $B_u$  of 0.85 per cent NaCl solution at rate of per cent  $B_u$  per hour ( .85% N Cl is 5% glucose solution produced more severe post administration muscular incoordination).

Group 4. Five healthy fasting men, loaded with 5 per cent  $B_u$  of 0.6 per cent NaCl solution ( rate of per cent  $B_u$  per hour by mouth.

was found to be almost impossible to drink rapidly two or three litres of sodium chloride solution without producing vomiting' (17)

Hoarseness and a sensation of 'heavy eyelids' are the only constant symptoms associated with a sensible load of 2.8 to 4.1 per cent body weight of the above solutions. Greater positive loads of salt solutions are associated with the gross collection of fluid in subcutaneous tissue, in body cavities and in some organs. Therefore gross overloads of 15 to 25 per cent body weight are associated with variable signs and symptoms that have an intimate relationship to the degree and rate of impairment of breathing circulation and renal function

Extracellular salt water excess rarely exists without a disturbance in the content of water in the body in relation to total solutes. A relative water deficit is commonly associated with it. This state is described below

*Extracellular salt water excess with relative water deficit* (Fig. 8) This syndrome may be readily induced during the postoperative period and after trauma by the exclusive use of an isotonic salt solution to provide for the water and salt needs of a person who cannot

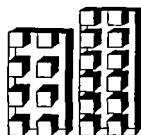


Fig. 8. At left, normal extracellular fluid, at right, extracellular salt water excess with water deficit.

eat or drink. It is physiologically analogous to the illness induced by drinking sea water to satisfy thirst.

If 0.9 per cent sodium chloride solution (159 mEq sodium per liter) is the only fluid infused into healthy fasting men the urine excreted during the first 24 hours does not contain much more sodium than the infusate per unit volume. Consequently the amount of water made available to the body from the saline solution is smaller than the insensible loss of water and the concentration of salt in body fluids increases.

If the intravenous injection of 0.9 per cent sodium chloride in water or 0.9 per cent sodium chloride in 5 per cent glucose into a healthy man is continued at a constant rate during the next 24 hours so that an amount of solution roughly in excess of 3 per cent of body weight is administered in 24 hours, a new equilibrium state tends to be established. This state is characterized by the excretion of the salt given that day and by a concentration of sodium chloride in the urine sufficiently greater than its concentration in the infusate so that enough water is thereby provided to balance the insensible loss, and the concentration of salt in the body remains at the level reached

the previous day or it decreases. If the above solutions are given as the sole source of water during renal insufficiency states or during the immediate postoperative period when the kidneys' ability to excrete sodium in high concentrations in the urine is limited, a much greater excess of sodium chloride and a greater deficit of water in relation to total body solutes will exist before the new equilibrium state is reached. Indirect evidence indicates that under certain circumstances the relative water deficit may reach such proportions as to be associated with anuria in the presence of edema. The syndrome of "acute salt intolerance" is now thought to be due to salt excess with a relative water deficit.

The symptoms and signs are as follows: disorientation, anorexia, nausea, vomiting, a diminishing rate of urinary flow in relation to the amount of fluid retained, hoarseness, and the collection of fluid subcutaneously, in the lungs, and in body cavities. The plasma sodium concentration tends to be elevated, and the red blood cell count and plasma protein concentration tend to be reduced. If oliguria is present, the nonprotein nitrogen of blood increases.

*Changes in composition of extracellular fluid* (Departure from the normal electrolytic pattern of extracellular salt water) Changes in the composition of extracellular fluid can be of many types. A few of them are hypoproteinemia, hyperproteinemia, hypocalcemia, hypercalcemia, hypochloremia, hyperchloremia and acidosis, alkalosis. Only two of them, acidosis and alkalosis of nonrespiratory origin, will be considered.

The degree of acidosis or alkalosis present should be looked upon as a measure of the organism's inability to compensate for a change in the relationship of the bicarbonate ion to the anions of stronger acids ( $\text{SO}_4$ ,  $\text{HPO}_4$ ,  $\text{Cl}$ , lactate) in the extracellular salt water. In other words the actual change in the hydron concentration (acidosis or alkalosis) is a measure of the effectiveness of the respiration, the renal function, and the buffer systems to compensate for an alteration in the relationship of acid ( $\text{H}_2\text{CO}_3$ ) to base bicarbonate ( $\text{HCO}_3$ )—HA/BA. This change in relationship in the type of acidosis or alkalosis con-

sidered here is due to a shift in the proportion of  $\text{HCO}_3$  to the sum of the other anions of stronger acids than  $\text{H}_2\text{CO}_3$  in the extracellular fluid ( $\text{Cl}$ ,  $\text{HPO}_4$ ,  $\text{SO}_4$ , lactic and other organic acids).

The signs and symptoms of a relatively uncomplicated<sup>1</sup> base-bicarbonate deficit ("acidosis") and of a base-bicarbonate excess ("alkalosis") are relatively mild. The reduction by one-half<sup>2</sup> of the base bicarbonate (to 10–14 mEq per liter) by drinking hydrochloric acid is attended by moderate dyspnea and hyperpnea with mild exercise, such as walking at one's usual rate on level ground and severe dyspnea after rapidly climbing three flights of stairs similar to that which may be experienced during the last 50 yards of the "440". There is no appreciable dyspnea or sense of fatigue at rest, but recovery of a feeling of well being after exercise is long delayed with the above base-bicarbonate deficit. No great change in the mental reactivity was noted at the above level of base bicarbonate deficit. Greater noncompensatory deficits of base bicarbonate to one-quarter of normal (7–8 mEq per liter) in adults (13) and to less than one-fifth of normal (4–5 mEq per liter) in children (13) may not be attended by any grossly detectable signs or symptoms indicating an impairment of the function of the central nervous system.

Similarly the elevation of base bicarbonate to 40 to 52 milliequivalents per liter of plasma ( $\text{CO}_2$  combining capacity 90 to 120 volumes per cent) may not be associated with any detectable mental or physical signs of illness, even the tendency to the development of muscular cramps and hyperexcitability of tendon reflexes may not be apparent. Hypopnea is difficult of detection without actual measurement of the minute volume of respiration. Therefore it appears that most of the symptoms usually ascribed to "acidosis" (base-bicarbonate deficit)<sup>3</sup> and "alkalosis" (base-bicarbonate excess) are the result of the concomit

<sup>1</sup>Acidosis—rapidly induced by drinking N/100 hydrochloric acid.

<sup>2</sup>Alkalosis—rapidly induced by drinking .03 per cent  $\text{NaHCO}_3$  in water.

<sup>3</sup>Disorientation, anorexia, nausea, vomiting, weakness, apathy, pain in muscles, paralytic ileus, hypotension, fast pulse.

ant disturbances in physiologic components other than base bicarbonate. Fagge in 1874 (9) first called attention to the apparent rôle played by dehydration (salt water deficit) in the clinical picture of diabetic coma and to the partial efficacy of the injection of a saline solution into the blood. However following Stadelmann's implication of acid poisoning as the cause of diabetic coma, the rôle of the salt water volume deficit in the picture of diabetic coma was largely forgotten for a time.

Within the last two decades Fagge's original ideas have been rediscovered, and it is now realized that salt water deficits (extracellular  $(\text{Na}^+ \text{Cl}^- \text{HCO}_3^-)$  and intracellular  $(\text{K}^+ \text{HPO}_4^{--})$ ) may quite frequently accompany nonrespiratory base bicarbonate deficits and base bicarbonate excesses. Consequently as more experience is gained in treating individuals suffering from disturbances in body fluid equilibrium, it is realized that the symptoms and signs of severe alkalosis or acidosis, with their ubiquitous physiologic effects, may be minimal and that it should be more generally realized that the direction of one's efforts toward their correction without taking cognizance of the relatively large neutral salt water deficits that are associated with them will occasionally result in inadequate salt water replacement. Then the signs and symptoms ordinarily ascribed to the alkalosis or acidosis, excepting those related to respiration and in the case of alkalosis those relating to ionized calcium deficit, may persist though to a lesser degree after the carbon dioxide combining capacity has been returned to normal. Therefore, in the treatment of a base-bicarbonate excess or deficit the replacement of the attendant neutral salt water deficit should always be kept in mind. See Table IV for the treatment of acidosis and alkalosis.

**Extracellular salt water distributional shifts** (Fig. 9) (Reciprocal variations in the extracellular salt water volume of various tissues, with the total extracellular salt water volume of the body remaining constant.) This type of disturbance in fluid equilibrium is frequently seen by the surgeon. Varying degrees thereof universally accompany all trauma. The experiments of Underhill, Kapsinow and Fiske

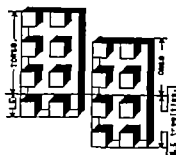


Fig. 9. Extracellular distributional shift from torso to lower extremities.

(23) demonstrated that the rate of shift of fluid into an injured area is rapid and that after the fluid has entered the injured area, it does not leave it in appreciable amounts for 50 to 70 hours. The increment of fluid in the injured area actually constitutes a functional loss of salt water and plasma proteins from the body (the uninjured part). Red blood cells also collect in the injured tissue largely because of the capillary dilatation and the static flow of blood in it. This constitutes a functional hemorrhage although the total red cell volume remains within normal limits as determined indirectly from the hematocrit and plasma volume determinations or directly using carbon monoxide.

A distributional shift of body fluids following trauma is similar to an uncomplicated extracellular salt water deficit or a chronic water deficit. Clinically significant distributional shifts of body fluids are associated with trauma (mechanical, e.g. crushing injuries, fractures of the pelvis and femora; major operative procedures; thermal e.g. scald and burn and chemical, e.g. peritonitis following perforation of the duodenum or gall bladder) with thrombophlebitis with infections such as gas gangrene, typhus fever and trichinosis and with toxic dermatoses. This list is not complete.

Salt water (see Table IV) distributional shift) blood and plasma protein constitute the basic therapeutic elements in the treatment of distributional shifts of body fluids.

More detailed and specific directions for the treatment of disturbances in the equilibrium of body fluids than those included in this paper can be found in the *Journal of the American Medical Association* (3) and in the *New England Journal of Medicine* (1).



tually increase as an extracellular salt water volume deficit occurs as a result of pancreatic or biliary drainage, and it may be below normal when the extracellular fluid volume is normal (hypochloremia secondary to a primary carbon dioxide excess as in emphysema, asthma, depression of breathing by opiates) or when the extracellular salt water volume is even greater than normal (hypochloremia secondary to an excess of water as in water intoxication).

The weight of the body from day to day is not an universally sound physiologic basis for the determination of the salt and water needs of the individual. Distributional shifts of extracellular salt water into the subcutaneous tissues or into serous cavities occasionally occur rapidly and as a result thereof the rest of the body suffers from the depletion of its extracellular salt water—there is need for salt water even though the individual's weight has not changed. Conversely an individual who has been given salt water or plasma in the treatment of injury (burns) usually begins to lose weight rapidly between the fourth and seventh days as the edema of the burned area subsides. Salt water should not then be given to the patient even though he is losing weight because he is excreting the salt that was given to him while the edema was forming and now that the edema is subsiding the salt constitutes an excess. If one assumes that except for the above types of illnesses, weight change is a sound basis for controlling fluid administration he assumes that the ideal water and salt contents of the body are constant. This is likely not true though only a small amount of exploratory research work has been done on the possible changes in the ideal<sup>1</sup> body content of water and salt associated with various ills. Under certain circumstances the "ideal" water and salt contents of the body may be larger and under others smaller than they are in the healthy individual.

When determinations of the volumes of plasma and extracellular salt water can be made easily and repeatedly they may become valuable aids in the diagnosis and treatment of disturbances in body fluid equilibrium.

<sup>1</sup>"Ideal" contents may be defined as those most conducive to the rapid recovery of health.

Changes in the concentration of plasma solutes and red blood cells are most valuable as checks of the appropriateness of the diagnosis and treatment.

Because there are no simple dependable means of detecting small extracellular salt water deficits, the daily parenteral administration of salt to those who cannot eat or drink is presumably an expedient that should be employed even though no salt is being lost through extrarenal channels or sequestered in diverse regions of the body. How much salt should be given under these circumstances?

Because healthy nonfasting men habitually eat 2 to 10 grams of salt daily it has been felt that a sick man who cannot eat should receive parenterally at least 5 grams a day in order to maintain his salt balance.<sup>2</sup> However men suffer no apparent harm if their salt intakes are reduced to 1 gram daily. The Tlascalan Indians forgot the taste and the use of salt after they had been cut off from salt for centuries (16). Infants sustain their most rapid period of growth on about a gram of sodium chloride per diem.

It appears likely that the salt that man ingests daily is dictated by taste and habit rather than by actual need, and that healthy men in general have within their bodies more salt than is actually necessary for the maintenance of health. Quantitative salt excretion studies lend support to this idea. The question of the optimal salt intake, during a fast, is still unanswered. From a surgical standpoint, the routine parenteral administration of 5 to 9 grams of salt daily when there is no abnormal functional loss thereof is in certain instances capable of delaying recovery. In fact, a slight deficit of extracellular salt water may be preferable to any excess (even 5 to 9 grams daily) especially during the immediate postoperative period. This belief is supported by a number of reasons.

1 For 2 to 4 days after any injury injected salt solutions tend to collect most rapidly and to a relatively greater extent in the area of injury (19). This phenomenon is very easily demonstrated in anyone upon whom a colostomy has been performed. If no saline is given the transudation from the surface of the loop will be relatively small and it swells

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relatively little, if then 2,000 cubic centimeters of 0.9 per cent saline solution are administered, the transudation and swelling increase rapidly. An enteric anastomosis behaves in the same way, the edema that occurs about the region of the anastomosis is greater if saline is given. Therefore, the resumption of the normal continuity of the intestine following an enteroenterostomy or enterocolostomy will tend to be longer delayed as the amount of salt injected is increased. On one occasion an edematous occlusion of a gastrojejunostomy stoma was found to be the cause of a complete gastrojejunal obstruction 24 days after a subtotal gastric resection. The mass of salt given daily was 4 grams over that lost as gastric drainage. No subcutaneous edema was present. Following the second operation, although no corrective operative procedure was carried out, the functional patency of the anastomosis was established after 4 days of a zero intake of salt. The rate of healing of wounds tends to be related inversely to the local edema; the greater the edema, the slower is the rate of healing. This is most clearly demonstrated in the experiments performed by Glen, Gilbert and Drinker.

2. The incidence of postoperative pulmonary complications after upper abdominal operations is higher especially in the aged when maintenance doses (5 to 9 grams daily) are in excess of need appear (Unpublished data.)

3. A deficit of extracellular salt water is more easily corrected than an excess. The adoption of the policy of withholding salt during the immediate postoperative period until signs of its need appear shifts the responsibility for the maintenance of a physiologically adequate extracellular salt water volume from the kidneys of the patient to his physician. This responsibility is big. If signs of illness are present or appear after an operation or injury that are attributable to a functional extracellular salt water deficit contracted by an external loss or an internal shift thereof, vigorous saline therapy must be instituted and the consequences of local edema forgotten.

If there are indications for the parenteral administration of fluids, what solution or solutions should be employed? In general the

solution used should be so composed as to effect the return to normal of the various deformations of the body's fluids without producing other deformations that may be more difficult of accommodation by the organism than the original ones were. Obviously, if the kidneys of all sick individuals would perform as do those of healthy men the manufacture of a universally applicable repair solution would be feasible, in fact 0.9 per cent sodium chloride in water or in 5 per cent glucose (glucose-saline) could serve in that capacity.

If a water deficit existed, it could be corrected by the administration of 0.9 per cent sodium chloride in amounts in excess of 3,000 cubic centimeters daily, should the kidney excrete urine that contained 1.8 per cent salt, for then all the salt injected could be excreted in one-half the volume of water that was injected as 0.9 per cent salt, thus making available to the body a volume of water equal to the volume of urine.

If a water excess existed and the kidney excreted the sodium chloride in 0.9 per cent concentration or lower the water content of the body would decrease by an amount equal to, or greater than, the insensible loss of water.

If alkalosis existed, the excess of chloride relative to sodium in the 0.9 per cent sodium chloride solution, compared to sodium in plasma (the concentration of chloride relative to sodium in plasma would serve to reduce the alkalosis (the concentration of alkali) even should the kidneys put out no urine. If acidosis was present, the administration of 0.9 per cent sodium chloride would permit its correction if the kidneys were capable of excreting sufficiently greater amounts of chloride than sodium.

However, the kidneys of men and women who have been injured or operated upon are relatively unable to excrete a urine having a higher concentration of sodium chloride than is present in 0.9 per cent sodium chloride, and consequently water deficits tend to be increased rather than alleviated by the administration of 0.9 per cent sodium chloride solution. In addition, the kidney's ability to excrete chloride in excess of sodium is reduced following trauma or an operation, and therefore the correction of an acidosis with sodium chloride may be impossible.

In other words, solutions of 0.9 per cent sodium chloride in water or in 5 per cent glucose (glucose-saline) are not universally applicable repair solutions because the renal function tends to be depressed following operations and trauma. Therefore, the solutions employed in the correction of fluid disequilibrium states should be so constituted as to effect the correction without depending upon the kidneys.

The solutions that fit the physiologic requirement for the correction of the fluid disequilibrium states described herein are listed in Table IV.

The volume of fluid administered and the rate of administration depend largely upon the response of the individual and the constitutional severity of the depletion.<sup>1</sup> Usually the volume of salt solution given in 24 hours should not exceed 6 per cent of the weight of the body unless the rate of functional loss of extracellular salt water continues at a rapid rate, either as a result of the continuance of distributional shifts (burns, trauma, peritonitis, gas gangrene) or as a result of continued high rates of external loss (ileostomy, colostomy or other fistulous drainage). Under these latter conditions the infusion of salt water may have to be continued to 10 to 15 per cent of the weight of the body per 24 hours. When a rapid rate of infusion is employed or a large volume of fluid is given repeated auscultation of the chest and gross determination of venous pressure should be performed. If rales appear or if the veins of the neck become distended and tense the infusion should be temporarily discontinued.

After the correction of deficits has been effected, the amount of salt water given daily will depend upon the continued existence of the cause of the deficit. If the cause of the deficit is a distributional shift due to an injury the movement of extracellular fluid into the injured part will tend to decrease rapidly so that after 36 hours there will be little further shift. After 72 to 100 (23) hours have elapsed after the injury the extracellular fluid in the injured part will begin moving back

into the rest of the body and no more salt should be given because a functional excess of extracellular salt water then exists. If the loss of extracellular salt water continues (because of hyposthenuric nephropathy, fistulous drainage, diarrhea, vomiting, gastroduodenal drainage) the loss of salt should be made up, as it occurs, by the injection of a saline solution that has the salt compositional pattern of the body fluid lost.<sup>2</sup> (See Gamble for the composition of various body fluids.) If no salt is lost after the correction of the deficit, very little if any need be given.

Another general physiologic principle that should be kept in mind when one prescribes parenteral fluids is: A primary change in the body's content of one substance is associated with changes in the organism's content of other substances consequently the restitution to normal of the primary change in content does not insure the restitution to normal of the secondary changes upon which the ultimate recovery of the person may rest. For example a man who excretes large amounts of hydrochloric acid into his stomach, develops pyloric obstruction and vomits a large amount of chloride and a smaller amount of sodium are lost in the vomitus. This increases the concentration of base-bicarbonate in the body and the pH of the extracellular fluid increases, respiration slows and the amount of carbon dioxide in the body increases, base-bicarbonate is excreted through the kidney and the body's content of base and consequently of extracellular salt water are thereby diminished. Sodium enters the cells of the body (6) and potassium leaves them to be excreted; a deficit of potassium is incurred thereby. The volumes of plasma and of extravascular extracellular salt water decrease, plasma protein leaves the blood stream (8) and the total circulating protein falls although none is lost externally. The red cell mass actually declines although the hematocrit may rise (14).

Now let the extracellular salt water volume deficit be replaced by the infusion of 0.9 per

<sup>1</sup>Swain, give NaCl 45 to 60 per cent, gastric drainage with free hydrochloric acid in it, give NaCl 45 to 60 per cent; hyposthenuric nephropathy and enterostomy drainage (ileostomy or long-tube section) give NaCl plus NaHCO<sub>3</sub> plus KCl (see Table IV); pancreatic fistula, give osmotically equivalent amount of NaCl plus NaHCO<sub>3</sub> (5 grams NaCl plus 4 grams NaHCO<sub>3</sub> per liter).

<sup>2</sup>Man with extracellular salt water depletion associated with signs of "shock" receives more solution at faster rate than those having extracellular salt water depletion without signs of "shock."

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cent sodium chloride solution the chloride and sodium deficits and a part of the carbon dioxide and base-bicarbonate excesses are relieved. There still exists a deficit of plasma protein, a deficit of red blood cells, and an intracellular potassium deficit and sodium excess. (The chemical signs of an intracellular potassium deficit are a persistently high carbon dioxide combining capacity, a high blood urea (or non protein nitrogen), and a low chloride concentration in plasma [4].) If an attempt is made to "correct" the high carbon dioxide combining power and the "hypochlor emia" by further administration of sodium chloride, the deficit of potassium tends to be aggravated regardless of whether the sodium chloride is retained or excreted and the chloride concentration of plasma remains low and the carbon dioxide combining power high.

Therefore, it is obvious that the infusion of sodium salts alone will not satisfy the physiologic demands of the organism after reconstitution of the extracellular salt water volume and that the transfusion of whole blood and the administration of potassium salts should be considered as integral parts of the treatment of a large salt water deficit (7) especially if it has developed slowly and is associated with pronounced physical signs such as great weakness, atonic muscles and hypotension. Upon theoretical (10) and clinical grounds the transfusion of blood should be withheld until partial reconstitution of the extracellular volume has been effected in order to minimize the tendency for the intravascular agglutination of red blood cells and clotting. Darrow (4 to 7) has demonstrated recently that a deficit of potassium frequently accompanies disturbances of extracellular fluid equilibrium and that it has great physiologic and clinical significance.

## SUMMARY

A clinical plan is presented for the recognition of disturbances in the equilibrium of body fluids.

The disturbances in equilibrium considered are (1) acute water deficit (2) chronic water deficit (3) absolute water excess (4) extracellular salt water deficit, uncomplicated (5) extracellular salt water deficit with water deficit

(6) extracellular salt water deficit with water excess (7) extracellular salt water excess (8) extracellular salt water excess with water deficit, (9) changes in composition of extracellular fluids (electrolytic pattern) (10) distributional shifts of extracellular salt water.

The general principles of therapy involved are

1. It is better to treat the man than it is to treat his "blood chemistry," plasma proteins, hematocrit, or weight. A presumptive clinical understanding of the types of disturbances in the equilibrium of body fluids may be gained from a correlation of the history and the physical examination of the patient. The laboratory data are valuable as checks of the diagnosis and treatment, but they should not be used as primary bases for either

2. Sodium salts should be given when they are needed and should be withheld when they are not.

3. A primary change in one physiologic variable, such as the sodium content of the body is attended by secondary changes in other physiologic variables, consequently, the reconstitution of the primary variable to "normal" content does not insure the return to normal of the secondary variables upon which ultimate recovery may rest. Decreases in the volume of circulating red blood cells and plasma proteins and in the mass of intracellular potassium are important secondary variables associated with sodium deficiency, especially if the sodium deficit has developed slowly.

4. The kidneys of patients treated by the surgeon are often not "alert" enough to alter a 0.9 per cent solution of sodium chloride to fit the need of the organism therefore, appropriately balanced salt solutions should be used.

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## USE OF BLOOD AND BLOOD SUBSTITUTES

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IN recent years much new information regarding the nature origin and function of different elements of the blood has become available through the researches of biochemists physiologists and clinicians. In many instances the clinical applicability of such information has been obvious and the patient has derived immediate benefit. In this field as elsewhere in medicine progress in the care of the sick depends not only on the fundamental contributions from laboratories of basic science but on the clinician's alert and intelligent appraisal of new facts and on his skilful application of these new facts in the clinic.

Whipple and his collaborators have done much to define the facts of protein metabolism and the conditions governing the regeneration of the plasma proteins and hemoglobin (10 14 15). The quality and quantity of protein ingested the state of the liver the presence or absence of infection or intoxications and the factor of individual organismal variation and the availability of iron to the body have been shown to be critical conditions in the maintenance of normal hemoglobin and plasma protein concentrations and blood volume. They have shown that the healthy animal for example can replace all its circulating plasma protein in 3 days under the stimulus of plasma withdrawal while taking a protein rich diet. Hemoglobin which contributes six times as much protein to the blood as does plasma protein takes about six times as long for replacement. Body protein accretion (both new hemoglobin and tissue protein) is believed to go through the transition stage of plasma protein. The protein of the plasma thus constitutes a pool which is drawn upon by the cells throughout the body and which is in constant interchange with cell protein. The studies of

Schoenheimer and others using tagged elements supports the conception of continual and rapid movement of amino acids through out the proteins of the body. The blood then must be regarded as a tissue which is in dynamic equilibrium with the other tissues of the body and its composition and volume are maintained relatively constant only through a set of remarkably complex and continuous reactions.

Of particular interest to surgeons also is the work of Cohn and his group in the fractionation and characterization of the plasma proteins (3 4 9). As methods have been developed for the separation of the different proteins of the plasma it has become possible to prepare them for tests of their function with a consequent better understanding of the physiological rôle of the individual fractions. The properties of the different fractions are of great clinical importance and must be considered in the intelligent use of blood and blood substitutes. For example the colloid osmotic force of plasma proteins is essential to the maintenance of the volume of the circulating blood and when the plasma protein concentration falls below a so-called critical level in the neighborhood of 5 grams per 100 cubic centimeters reduction in blood volume and dangerous tissue edema may occur. It must be remembered however that the albumin fraction is much more important than the globulin fraction in this respect, for although the albumin molecule comprises only about 60 per cent of the plasma protein it is a much smaller molecule than globulin and provides about 80 per cent of the colloid osmotic pressure of the plasma. It has been shown that the antibody properties of the plasma reside in the globulin component and reduction in this fraction by malnutrition prolonged abnormal loss or impairment of the body's power to form globulin lowers resistance to infection (2). The clotting power of the blood depends particularly on two components of the plasma protein namely, fibrin

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# USE OF BLOOD AND BLOOD SUBSTITUTES

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**I**N recent years much new information regarding the nature origin and function of different elements of the blood has become available through the researches of biochemists, physicists physiologists and clinicians. In many instances the clinical applicability of such information has been obvious and the patient has derived immediate benefit. In this field as elsewhere in medicine progress in the care of the sick depends not only on the fundamental contributions from laboratories of basic science but on the clinician's alert and intelligent appraisal of new facts and on his skilful application of these new facts in the clinic.

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ogen and the globulin prothrombin. In addition, an antihemophilic globulin has been isolated and this element, missing in hemophilia, can be supplied from normal plasma to control the bleeding of hemophilia. Largely through the work of Cohn and his group under the stimulus of war time needs, these various derivatives of the plasma proteins have been put to practical test for the benefit of the sick and the wounded.

These remarks serve as a reminder that in the use of blood and blood substitutes in surgical practice one is dealing with fundamental physiological considerations. The better the understanding of the need of the patient, the clearer the objectives and the less empirical the practice, the better the result.

The rest of this discussion will be concerned with two common surgical problems, namely hemorrhage and secondary shock. These conditions will be considered in relation to therapy by the intravenous administration of whole blood plasma, albumin solution and protein hydrolysates. By the latter term is meant the mixture of polypeptides and amino acids formed by the enzymatic breakdown of a high quality protein such as casein or lactalbumin. Such hydrolysates in 5 or 10 per cent solution are nonallergenic and nonpyrogenic when properly prepared. They may be regarded as a blood substitute in that they provide the essential amino acids for the construction of plasma protein and hemoglobin when given intravenously.

**Hemorrhage.** In the healthy adult the volume of the blood comprises about 8 per cent of body weight, but variations of from 6 to 10 per cent have been found in different individuals (8-18). The blood volume tends to remain constant in the same individual and is probably more closely related to surface area and height than to weight. The healthy person can withstand a sudden loss of one third the blood or even more (up to 1.5 or 2 liters) but this is not true of many of the patients the surgeon must treat. Malnutrition, previous hemorrhage, infection, trauma, disease of cardiovascular system, liver or kidneys, reduce the power of the organism to make the life-saving adjustments required in overcoming critical blood loss.

As previously noted the blood volume is not to be regarded as a fixed entity as if contained in a rigid walled vessel. Not only may the size of the vascular bed vary rapidly through vasodilatation or vasoconstriction and ischemic shunts, but the blood is in diffusion equilibrium with the larger reservoirs of interstitial and intracellular fluid. With loss of blood an immediate inflow of fluid from outside the capillary bed begins, a process which is detectable by fall in red cell count and hematocrit. Furthermore in hemorrhage protein is mobilized from parenchymatous organs such as the liver and red cells are drawn into circulation from the spleen and bone marrow. The more rapid the loss of blood, the less the time for successful compensation and the lower the physiological reserve of the patient the smaller his capacity to endure hemorrhage. It has been shown by studies of hemorrhagic shock in animals that the longer hemorrhagic hypotension and tissue anoxia are allowed to go uncorrected the less the likelihood of survival. After a certain point damage to such organs as the liver and brain becomes progressive. The urgent need for correction of blood loss is thus emphasized. Ideally the loss of blood should be made good as it takes place.

A great service has been done practicing surgeons by Coller and his co-workers, as well as others, in providing evidence that the amount of blood lost during common operations in good hands may be large (1.5-6.7-12-20). Many surgeons unquestionably had failed to appreciate that operative and post-operative shock commonly stemmed from uncorrected hemorrhage. Further proof is convincingly available in the major teaching clinics of the country today where by the free use of blood transfusion during and after operation surgical procedures of hitherto impossible magnitude are being successfully performed (13). As Coller has pointed out, (a) the amount of bleeding at operation is almost always greater than the surgeon suspects, (b) there is no practicable method of measuring the extent to which bleeding has occurred at any given time during operation and (c) replacement is most effective when whole blood is given as the loss occurs (5). Every

## STEWART USE OF BLOOD AND BLOOD SUBSTITUTES

surgeon undertaking major surgical procedure should familiarize himself with the range of values for blood loss at various operations and ideally he should measure the losses at his own hands in a series of cases

The replacement therapy for massive hemorrhage seems obvious though from time to time the obvious has been held suspect. Whole blood has been lost in the operative field into body cavities into tissue planes or to the surface and whole blood should be given in treatment (11-19). The blood must be carefully matched it must be given in large enough quantity it must be given without delay. The acutely depleted blood volume lowered cardiac output and tissue anoxia urgently require relief. In acute hemorrhage plasma or albumin injected intravenously will increase blood volume but further dilution of hemoglobin and crippling of the mechanism for oxygen-carriage results. Under these circumstances the systolic blood pressure may temporarily rise and produce a false sense of security while the patient's condition is actually worse.

Following a severe nonfatal hemorrhage unless the loss has been completely corrected by blood transfusion a period ensues during which anemia, hypoproteinemia and reduced blood volume are common findings. Unless the patient is receiving large amounts of iron the anemia is apt to be of the hypochromic microcytic type and the hypoproteinemia may be associated with a relatively greater reduction of albumin than of globulin. During the convalescence from severe hemorrhage further blood transfusions are still frequently in order but protein requirements may be advantageously contributed to by infusions of plasma and albumin. A better source however of amino acids is protein hydrolysate in 5 or 10 per cent solution.

**Secondary shock** In the state of secondary shock as distinct from neurogenic transitory hypotension there are present reduction in cardiac output and blood flow fall in blood pressure and usually evidence of peripheral arteriolar constriction. As a rule there is lowered basal metabolic rate and body temperature rapid pulse shallow respiration and sweating. Secondary shock may be seen in

medical as well as surgical conditions and the syndrome may be classified on an etiological basis as follows

- 1 Loss of propulsive force, or cardiogenic shock as seen in coronary occlusion and severe cardiac arrhythmias

- 2 Dilatation of the vascular bed as seen in overwhelming invasive infections or in transection of the spinal cord

- 3 Mechanical interference with blood flow as in volvulus of the intestine cardiac tamponade tension pneumothorax pulmonary embolism or mesenteric thrombosis

- 4 Primary reduction in blood volume as in wound shock hemorrhage, burns war gas poisoning and severe dehydration

The classification of secondary shock in this manner is of value in that it emphasizes the varied nature of forces which may produce the same clinical picture though in many cases more than one of these major causes may be at work. It follows that treatment will vary likewise.

It is probably a fair assumption that reduction in cardiac output is present in secondary shock due to any of the above causes and that lowered blood volume is present in most instances. However, blood transfusion may be dangerous rather than beneficial in cardiogenic shock or pulmonary embolism and though blood transfusion is helpful in intestinal strangulation it is equally important to correct the mechanical defect by early surgical operation. In the state of secondary shock due to fulminating infections restoration of blood volume by infusions of plasma and by blood transfusions is in order but of greater urgency perhaps is treatment of the infection itself as by surgical operation antibiotics and sulfonamides depending on the case (17). The uncritical use of blood transfusion in secondary shock without analysis of its cause is therefore to be condemned.

In the state of secondary shock due to losses from the circulation or in other words in primary oligemic shock, successful treatment must be based on knowledge of the nature of the losses. In wound shock, including the shock incident to surgical operation oligemia is due to loss of whole blood and the treatment that is needed is blood transfusion in su-

ficient volume. Furthermore the treatment of such cases of hemorrhagic oligemia does not end with recovery from the hypotension as was pointed out above. Incomplete restoration of lost blood, the presence of complicating infection, the wasting effect of the reaction of injury, raise the need for protein. The intravenous route must often be employed in meeting this need, and 5 or 10 per cent amino acids solutions, plasma, albumin and whole blood must be given.

To illustrate the need for discrimination further, the parenteral fluid requirements in wound shock and in burn shock may be compared. In both conditions there is severe reduction in the volume of circulating blood. In wound shock, however, whole blood has been lost, and the hematocrit and red cell count are normal or low; the plasma protein concentration is normal or low. In burn shock, plasma has been lost in large amounts and albumin frequently to a greater extent than globulin; the hematocrit and red cell count are sharply elevated. Correction of blood composition here is important as well as restoration of blood volume and the immediate intravenous therapy of choice is infusion of plasma or albumin solution. In both wound shock and burn shock blood and protein hydrolysates and to a less extent plasma and albumin solution may be required intravenously in later convalescence.

#### CONCLUSIONS

In conclusion certain general principles involved in the use of blood and blood substitutes in the treatment of hemorrhage and shock are listed.

1. Careful matching of blood before transfusion is essential in minimizing reactions and renal damage; plasma for infusion should be of the pooled mixed variety or it should be typed.

2. Deficiency of hemoglobin and deficiency of plasma protein often occur together, whether the lack is acute or chronic.

3. In the restoration of depleted blood volume by intravenous injections normal blood

composition as well as normal volume should be the aim.

4. Acute losses of hemoglobin are less easily repaired by the body than are losses of plasma protein.

5. In infections, toxic states and trauma regeneration of hemoglobin and plasma protein may be greatly impaired.

6. The longer tissue anoxia due to hemorrhage and shock is allowed to go uncorrected the less the likelihood that the patient will recover.

7. In hemorrhage and shock as seen in surgical patients the need for blood transfusion and for infusions of protein and the protein derivatives often continues during convalescence.

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# LIGATION OF THE INFERIOR VENA CAVA IN THROMBOSIS OF THE DEEP VEINS OF THE LOWER EXTREMITIES

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**L**IGATION of the major veins to limit propagation of blood clots and prevent pulmonary embolism has become a standard procedure. The point of ligation of the involved vein depends upon the level of the blood clot and the extent of disease of the vein. The only safe rule to follow is to ligate above the clot through a normal segment of vein just below a main tributary. The majority of cases of thrombosis of the veins of the lower extremity can be detected while the clot is still below the inguinal ligament. In these, ligation of the femoral vein for the deep venous thrombosis, and the same phenous vein for superficial thrombosis usually terminates the process. However in some the disease has extended to such a level that ligation of the inferior vena cava becomes necessary. Ligation of the inferior vena cava is not a new procedure. It has been quite widely used in pelvic thrombophlebitis. However it has only recently been used to any extent in the treatment of thrombosis of the deep veins of the lower extremities. We have performed ligation of the inferior vena cava in 30 cases of ascending thrombosis of the deep veins of the lower extremities. A report of these cases forms the basis for this communication.

## INDICATIONS FOR LIGATION OF INFERIOR VENA CAVA

Although the indications for ligation of the inferior vena cava were essentially the same in all of our cases, the basic venous pathology was quite varied (Chart 1). In this series there were 3 types of venous thrombosis, namely phlebothrombosis, acute femorotibial thrombophlebitis, and thrombophlebitis in varicose

veins (Table I). The relative dangers of pulmonary embolism in the various types and the necessity for ligation of the inferior vena cava in the cases we are reporting can best be shown by description of the pathology and clinical course of each type.

## PHLEBOTHROMBOSIS

Phlebothrombosis usually begins in the small veins of the legs or feet. The clot is attached at first only at its origin. Propagation is the characteristic quality of this type of venous thrombosis. As the original mass of clot begins to organize the vein wall at this level becomes thickened, edematous, and inflamed. As new clot is added it extends steadily upward floating freely in the blood stream. The clot gradually fills the involved veins and eventually becomes organized and fixed to the vein wall. This process may require many weeks. Until there is complete organization and fixation of the thrombus it may be dislodged at any time and produce pulmonary embolism. Phlebothrombosis is particularly dangerous because at first there may be no local symptoms. Its existence often becomes known only after the patient has suffered one or more episodes of pulmonary embolism. As the clot extends upward more venous channels become occluded and local signs and symptoms develop. In all of the cases in this series there were local signs and symptoms of venous thrombosis. The common signs are edema of the foot, ankle, and leg; dilated superficial veins; cyanosis of the nail beds; and often a fall in local temperature. Pain in the calf is the most important symptom. This may be constant but is more often noted on motion of the foot or leg or on pressure over the veins. Fever is frequently absent and when present is quite mild. Leucocytosis is usually absent. Phlebothrombosis of the deep veins of the legs accounted for 25 of the cases in this series.

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# VEAL, ET AL. THROMBOSIS OF DEEP VEINS OF LOWER EXTREMITIES

pathetic blocks were performed over a 3 day period before there was relief of symptoms. The deep veins became thrombosed and superficial collaterals developed rapidly.

The remaining 4 unilateral cases all developed thrombosis of the deep veins of the normal side with massive edema of that limb. The process was gradual and at no time was there any disturbance of the arterial circulation. In all of our 30 cases there has been some degree of postoperative edema of both legs. This has been controlled by properly fitted elastic stockings. We have used a series of leg exercises in order to expand the collateral circulation gradually (Chart 3). The legs are elevated on 4 soft pillows immediately after operation. Walking motion exercises of the feet and legs are given frequently. As the edema subsides or if negligible throughout the pillows are gradually lowered. About 10 days following operation the patients are allowed to dangle legs over the side of the bed—still using the exercises. About 14 days after the operation the patients are allowed to walk. Elastic stockings are then fitted and are worn at all times except while in bed. The patient gradually resumes free activity. All of the patients that survived have been rehabilitated to the point of resuming full time occupations. There has been no ulceration of the legs. There is a marked difference in the rapidity of development of collaterals in the males and females. In the males the superficial collaterals have predominated in the females the deep collaterals, and often there is no dilatation of the superficial veins.

## VENOUS COLLATERAL PATHWAYS FOLLOWING LIGATION OF THE INFERIOR VENA CAVA

When the inferior vena cava is ligated many collateral pathways develop. Some of these carry blood back to the inferior vena cava above the point of ligation others communicate with the portal vein or the superior vena caval system. Among the most important deep collateral routes is the communication of the hypogastric vein with the inferior mesenteric vein through the hemorrhoidal plexus. Another major route is from the external iliac vein through the inferior epigastric vein to the superior mesenteric vein and thence to the

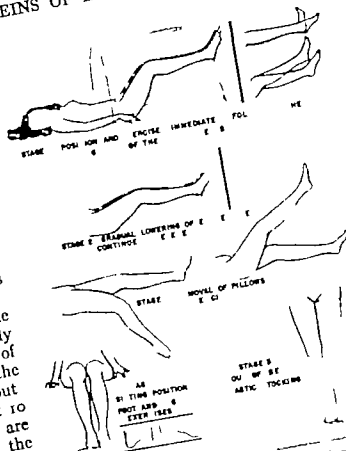


Chart 3 Postoperative measures to restore venous circulation

superior vena caval system. In women an additional important deep pathway is found in the ovarian veins which have access to blood from the hypogastric veins through the pelvic and uterine plexuses and deliver it to the inferior vena cava directly or via the renal vein. In men the homologous pathway through the spermatic veins is considerably less efficient, which probably explains the clinical observation that the superficial abdominal veins usually are more prominent in men than in women after ligation of the inferior vena cava. The main superficial collateral circulation is from the femoral vein through the superficial epigastric vein to reach the superior vena caval system by communication with the lateral thoracic vein. Other veins which contribute to the collateral circulation include the vertebral venous system (communication through pelvic plexuses) the lumbar veins (communication through the deep iliac circumflex vein and ilio-lumbar vein) and the superficial iliac circumflex and superficial internal circumflex branches of the femoral vein.



# NUTRITIONAL PREPARATION FOR SUBSTANDARD RISK PATIENTS

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THE number of publications which have appeared during the war years and since attest to the current interest among investigators and clinicians in nutritional problems. As a consequence of these efforts it is now possible to list better methods for solving the dilemma of the surgeon contemplating a major operation on a patient who is a substandard risk as a result of a chronic dietary deficiency. When from unhappy personal experiences, surgeons had learned to calculate the added risks these individuals suffered often in the past a number were denied benefits obtainable through surgery or if accepted after a genuine appraisal of the increased hazard the necessary surgical manipulations were found to be poorly tolerated. The patient seemed to react unfavorably from the outset with an instability of blood pressure out of proportion to the actual blood loss. Blood transfusions would often produce only a transient and unsatisfactory response. Frequently the convalescence was protracted complications developed to jeopardize the patient's life. In a considerable number a vitality sufficient to meet all the requirements for convalescence was so lacking that death occurred despite recourse to a variety of therapeutic measures. The usual autopsy findings of some incipient heart failure and bronchopneumonia, a fatty liver or a ure and wound healing were hardly an exoneration but rather confirmed the impression that malnourished individuals presented a substandard risk. Too frequently the issue will continue to be settled tragically if surgeons persist merely in restoring to normal the hydration, electrolyte status, and hemoglobin

content. The statement has facetiously been offered that some modern surgeons find it necessary to operate by the calendar while others can 'work by the clock.' However a measure of wisdom may well be with the former when dealing with chronically starved patients because an increased experience with the preoperative phase of dietary preparation indicates that the success of such nutritional hinge on the effectiveness of such nutritional care and makes unnecessary the completion of a hasty dissection before the patient's condition deteriorates. Such a statement implies that the pathologic biochemical states resulting from starvation are reversible after an appropriate dietary regimen. In nearly all except premortem instances this is possible. The rate at which the lost body protein can be replaced is much slower though than when balanced anew the body electrolytes or fluids. Sudden dramatic results which capture the attention are not the rule. The processes of nutritional restitution frequently require days may even take weeks and therefore demand of the surgeon patience. In this regard there is a real need as yet unanswered for simple accurate methods of determining how seriously starved the patient actually is how much nourishment and how long, should he be fed before an operation can be undertaken without an added risk. Fortunately however a partial restoration of the bodily stores usually suffices to permit performance of the necessary operative procedure. That is to say all the fat need not be forced from the liver nor all depleted tissues refabricated nor the hypoproteinemia completely corrected or the immune globulins and phagocytic values restored to normalcy. Even though short of this goal, after a reasonable period of satisfactory preoperative food intake the surgeon can then anticipate a convalescence virtually as free of complications as that encountered among the substandard risk group. A discussion of the method

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ods and nutrients employed upon the surgical service at the University of Minnesota Hospitals for realizing this represents the subject matter of this paper. It is hoped that the therapeutic outline offered will prove to have a broad practical application to the several nutritional problems faced by surgeons and by virtue of its relative inexpensiveness, simplicity of preparation and apparent effectiveness, merit trial in the preoperative dietary preparation of surgical patients.

#### FACTORS RELATED TO LIQUID DIETS FORTIFIED WITH PROTEIN AND CARBOHYDRATES

During semistarvation or starvation periods, man just as any experimental animal becomes autocannibalistic while deriving his energy from body fat and protein. This means that his diet necessarily is low in calories, carbohydrates, and protein but relatively high in fat. From this one might predict that a diet of opposite qualities, namely high in protein carbohydrates and caloric content, would be best suited to correcting those abnormalities ascribable to this starvation regimen. The results of numerous investigations and clinical experience have confirmed this impression.

Of these several constituents experience and experimentation have demonstrated that protein plays a chief rôle. The principal sources of protein in natural foods are meat, fish, eggs, certain dairy products and cereals. Yet, in each of these, the protein contributes but a fraction of the total bulk. It therefore becomes necessary to consume relatively enormous quantities of food when very high protein diets are desired. For example, to realize an intake of 300 grams of protein from beef a pot roast between 3 and 4 pounds would have to be eaten. This is a feat usually beyond the capacity of any individual weakened and apathetic from prolonged starvation and is an impossibility in the case of those patients with stenosis or obstruction due to a lesion at the pyloric outlet. Desirable as it may be to foster the consumption of a high protein diet by pleasant appearing tastily prepared menus, the physical factors indicated above limit the accomplishments possible by this means. In order to pyramid the intake from such means,

liquid dietary supplements fortified with a protein concentrate and ordinarily also a carbohydrate can be used. A variety of protein concentrates are at present available, and among these is skim milk powder with the following composition:

Components	Per cent
Protein	37.8
Casein	3
Lactalbumin	5.2
Lactoglobulin	5
Carbohydrate (lactose)	49.7
Fat	1
Water	3.0
Ash	3.5

An experience has been acquired with use of this fortifying substance in diets prepared for treating several hundred malnourished surgical patients on the surgical service of the University of Minnesota Hospitals. Skim milk powder has a low cost, is readily and widely available in quantity stores well in the bulk, and can be fairly well disguised in a variety of palatable mixtures. The proteins present are complete, possess a medium capacity to induce plasma protein regeneration under experimental conditions, and are rich in the liver protecting amino acid methionine. In addition much of our biologic information on nutrition has been acquired using those proteins present in skim milk powder. They have repeatedly proved excellent sources when fed in quantity.

The use of a liquid diet either as a supplement to the hospital fare or as the sole source of calories finds frequent and valuable application in the care of patients with surgical lesions of the esophagus, stomach, and duodenum. A tale of recent weight loss can usually be found written in their admission history. This is particularly true when mild or serious degrees of obstruction are an associated complication of the disease process. Here not uncommonly the oft repeated acceptance of an incompletely masticated bolus of solid food leads to an insoluble problem in aboral transport and results in an even greater degree of obstruction and retention. Yet, it has not been unusual to note that when the lumen has been freed of these chunks by repeated washings, very satisfactory volumes of a liquid diet are accepted daily with little or no retention.

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The fluid character of these liquid mixtures has an appeal for the dietetic staff burdened by a number of requests for special trays. Untrained workers can be easily instructed to perform the simple compoundings involved in the preparation of these formulas. Too the use of liquid diets with a fixed caloric value has made relatively easy and practical the measurement calculation and charting of the daily caloric intake on the same sheet with temperature pulse and respiration. Nutrition is thus brought into focus at the bedside whenever chart rounds are being held. This method of day to day contact with the problem and an accounting of the progress made consistently satisfactory care of those classified as substandard risks have been tried but the following with some variations, has appeared most adaptable



Fig 1 Drip feeding apparatus.

tubing and flow rates are thus visualized and regulated by a thumb screw attachment.

Most patients however are able to drink the mixture and as it is the taste is similar to that of an eggnog. It can of course be flavored to suit the individual desire with chocolate cocoa vanilla or other disguising substances. Some such variation is frequently employed by out patients undergoing dietary preparation. These patients can obtain skim milk powder by prescription from the bulk stock in the drug room. Simple mimeographed directions about preparation volume to be consumed daily, and the refrigeration requirements are given to them during the course of the out patient workup. A brief explanation to this group of the importance to them of this dietary preparation usually suffices to insure their co-operation. Preparation from the out patient approach is frequently possible except in the case of the very debilitated and hence reduces the actual period of hospitalization in many instances to about that for the more standard risk group. Whenever this liquid diet constitutes the sole source of food for the patient, he is urged to take if possible about 5000 calories, i.e. 3 liters daily. In the absence of obstruction this is no great problem and the consumption of quantities greater than this is not unusual. If the diet is used as a supplement, the acceptance of even a liter adds materially to the protein and caloric intake for that day. Diarrhea has been a problem sporadically. It usually can be avoided

## DIET II

Carbohydrates	408.8 gm.			
Protein	180.4 gm.			
Fat	37.2 gm.			
Calories	2,446.0			
Volume	1,500.0 c.c.			
Caloric equivalent	16			
	about	P	F	
	about	CHO		
		36.0	36.0	
		8.0		
		40.4	1.2	
6 whole eggs	58.8			
2 egg whites	300.0			
4 oz. skimmed milk powder	50.0	36.0		
300 gm. lactose				
1000 gm. skim milk				
5 gr malt (may be added when indicated)				
	408.8	120.4	37.2	

Beet, cane sugar or cerelese can be substituted.

This mixture passes readily through an indwelling nasal tube. It can therefore be employed as a drip feeding mixture in an apparatus similar to that in Figure 1. This is employed when caring for persons so enfeebled by their disease and starvation that it is impossible for them to make the efforts necessary to get adequate amounts of food from bedside trays. For this setup it has proved advantageous to use an intravenous flask with a dependent air vent. This permits the entering bubbles as they rise to agitate gently the mixture and hence reduces the tendency to plugging through sedimentation. A Murphy drip apparatus is inserted into the connecting



	Total	Ald.
PROPERATIVE NITROGEN BALANCE STUDY—Continued		
at 60 years, diagnosis,	=	
carcinoma of stomach—190 pounds weight loss	=	
INTAKE	=	

VARCO NUTRITIONAL PREPARATION FOR RISK FACTOR STUDY

Direct described in



through the maintenance of appropriate refrigeration of all portions of the diet other than the patient's immediate requirements and by the routine use of thoroughly cleansed or sterilized dispensing equipment. Should it occur despite attention to these precautions modest doses of paregoric and amphogel will ordinarily correct the situation. Patients with ulcerative colitis or regional enteritis are rather consistent exceptions to this, however and may develop an aggravatingly persistent diarrhea. The use of this mixture therefore is best avoided or limited to small quantities while testing the patient's tolerance.

As indicated earlier satisfactory objective measurements of the accomplishments of a refeeding regimen are virtually nonexistent. By trial and error methods it has been possible to arrive at estimates of how long a patient should receive a caloric intake augmented to about 4000 or more calories daily. From experiences with several hundred nutritional problems the conclusion has been reached that if 5 to 7 days are devoted to such dietary preparation for each 10 per cent of the body weight lost, the individual will consistently be able to tolerate extensive surgical procedures. These values are admittedly empirical and probably maximal rather than minimal. Until more critical tests are available however the present method offers a reasonably reliable means for calculating the duration of the special dietary regimen.

#### REASONS FOR DIETARY PREPARATION PREOPERATIVELY

It will be noted that emphasis has been placed upon preparation being preoperative. This appears to be an important consideration because the weight of evidence at this time indicates a greater retention of nitrogen ingested during this phase rather than after an operation. Data from a number of laboratories (2, 4, 7, 10) as well as ours (11) confirm the accelerated loss and difficulty of securing a favorable balance of nitrogen in the recovery phase after surgery. In addition such difficulties are pyramided when the patient after an intestinal operation is unable to take nourishment for several days because of ileus, nausea or vomiting.

#### OTHER SOURCES OF PROTEIN AVAILABLE FOR SUPPLEMENTING DIETS

Besides skim milk powder various substances are available as fortifying materials. The data of Madden and Whipple (6) suggest a number of possibilities. Two of these homogenized raw pork liver and powdered bovine plasma protein have been tested and each demonstrated (12, 13) to be definitely superior to skim milk powder for the production of protein. Unfortunately the possibility of controlling brucellosis appears too real to permit routine use of the former. The latter so far has been obtainable only in quantities sufficient for investigational purposes despite the fact that countless tons are potentially available in the blood now sold as fertilizer or stock feed. Whereas, estimates of manufacturing costs are high when calculated on the amounts available from a few pilot plants, the application of modern production methods on a larger scale would likely result in price reductions sufficient to permit its less restricted usage. The incentive to develop the manufacturing of this product by the packing industry necessarily will await a more generalized medical recognition of and demand for just such a superior dietary protein. In a similar fashion a large portion of the protein of fresh caught tuna, mackerel and sardines is lost to human consumption (3). This, under current commercial practices, inedible fraction can be separated from its unpalatable characteristics and in this purified form possesses high biological value for hemoglobin and plasma protein formation. These tests limited to date to small animals, might profitably be extended to clinical material. Yeast has received somewhat limited attention as a source of protein for humans due to its rather low content of sulphur containing amino acids and because of an objectionable odor and taste which are quite difficult to disguise. These several drawbacks have been virtually eliminated in products recently developed from new strains (9). The result is a powder virtually free of unpleasant aromatic or gustatory characteristics, with as much as a 70 to 80 per cent protein content. Its effectiveness as a dietary supplement for man remains unmeasured. These to mention but a few con-

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tributions of biochemists to general nutritional problems offer a partial solution of the search for more, better and cheaper proteins with high biological activity. Their trial in the management of clinical dietary problems assuredly seems warranted if the progress of our knowledge in this field is to parallel that in the laboratory. From the selection of materials now available for fortifying diets broad scope is offered to the investigator in developing those combinations achieving the greatest effectiveness with the least cost and with the best palatability.

## METHODS FOR PARENTERAL NUTRITIONAL PREPARATION

In certain nutritional problem cases, fortunately a rather small percentage the oral route is not available for protein and caloric repletion. On a surgical service this most often results from an obstructive lesion of the esophagus stomach or duodenum which will ultimately require a surgical procedure of magnitude. In this situation the surgeon has essentially two alternatives for alimentation. My personal experience with this operation has been a limited but rather consistently unsatisfactory one. Despite the employment of a wide variety of mixtures, severe diarrhea has invariably appeared before the quantity of material being fed reached a desirable level. The attainment of a substantial nitrogen and caloric balance under these circumstances has course unlikely. Even when this complication has been less troublesome convalescence has been less troubled. This may be related to the well documented temporary inability to anabolize protein that exists after a traumatic episode and which has been carefully studied by several workers *vide supra*. The other alternative is the establishment of a parenteral feeding program for the dual purpose of meeting the patient's current caloric needs, and securing the maximal nitrogen retention possible under the circumstances. To this end a daily carbohydrate intake of 200 to 250 grams is realized through the use of 10 to 20 per cent glucose solutions intravenously and isotonic glucose solutions subcutaneously. Unless this much sugar is available to the body for energy re-

quirements quantities either of the body proteins or of infused nitrogenous compounds continue to be catabolized for fuel. The magnitude of the carbohydrate intake therefore bears an indirect but quite essential relation ship to the state of the nitrogen balance. Direct control of the state of the nitrogen balance however is regulated by the kind and amount of nitrogenous compounds injected. A portion of these requirements can be provided by protein hydrolysates or pure amino acid mixtures (5). The latter has not been available so far in this clinic. Several definite limitations exist with the use of the former. Between 15 and 20 hours are required to complete the infusion of six thousand cubic centimeters of 5 per cent each of the protein hydrolysate amigen and of glucose. This is about the maximum quantity acceptable in each 24 hours. If this casein hydrolysate is injected at rates much faster than this or in greater concentrations, unpleasant systemic manifestations in our experience become more frequent. The nitrogen content of this considerable volume of fluid is theoretically equivalent to 225 grams of protein. In some cases with a long history of extreme privation and continuing rapid loss of protein (burns, massive ulceration etc.) this quantity of nitrogen would scarcely suffice if the entire amount were available for useful metabolic activity. Actually however in several experiments it has been demonstrated that the total nitrogen content of a 24 hour urine collection after a venoclysis of this type contains considerably more waste nitrogen than that obtained while feeding equivalent amounts of skim milk powder or powdered bovine plasma protein. There are at least two reasonable explanations for these findings. Since differences in biological activity have been demonstrated for proteins from various sources to casein (1) superior in all around qualities to casein (1) bovine plasma protein might provide a more utilizable hydrolysate if it were tried as the substrate. Or the hydrolysis by other than intestinal mechanisms, of these substances might lead to a decrease in the acceptability of the end products, perhaps through an incompleteness of processing. The salt content of amigen is of little consequence when only small

through the maintenance of appropriate refrigeration of all portions of the diet other than the patient's immediate requirements and by the routine use of thoroughly cleansed or sterilized dispensing equipment. Should it occur despite attention to these precautions, modest doses of paregoric and amphogel will ordinarily correct the situation. Patients with ulcerative colitis or regional enteritis are rather consistent exceptions to this however and may develop an aggravatingly persistent diarrhea. The use of this mixture therefore is best avoided or limited to small quantities while testing the patient's tolerance.

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volumes are being employed but attains real significance (9 grams in 6000 cubic centimeters of 5 per cent solution) when large volumes are in use. This item becomes even more important in the presence of the hypoalbuminemia frequently present in just this type of patient. States of overhydration due to such liberal administrations of salt and serious enough to require temporary cessation of this therapy have been noted.

This listing of these limitations should not be construed to mean that the intravenous administration of protein hydrolysates is fruitless for no one can seriously contend but that it has an important rôle in nitrogen replacement therapy. Rather it is hoped that the recapitulation of such inherent defects will bring their existence to the attention of those who have not so far appreciated them. Fortunately, the number of cases wholly dependent on parenteral feeding is in a minority. Such patients must be blessed with the services of conscientious house officer or interne because they demand of him and themselves an abundant patience and tact during the tedious hours of prolonged intravenous therapy. Without actually achieving the goal of large scale plasma protein regeneration those benefits which result from the employment of hydrolysates are certainly real and definitely worthwhile. Through their agency it is possible to halt or retard the steady protein losses from starvation and allied depleting mechanisms (ulceration, infection, hemorrhage). The nitrogen intake can also be augmented considerably by daily transfusions of plasma or whole blood. Although the total amount of nitrogen in a plasma or whole blood transfusion would be relatively small considered as dietary or hydrolysate nitrogen, it is proportionately more valuable because a significantly smaller fraction is lost in the urine the 24 hours after administration. This situation is particularly true when comparison is made with hydrolysate nitrogen. In this connection it appears only fair when calculating the cost of such replacement therapy to base one's ultimate conclusions on the amount of nitrogen the body actually retains and has available for functional purposes, rather than considering solely the price of each intravenous flask

and its contents. The use of whole blood and plasma, particularly when the latter is from a pooled source, is assuredly not an unmixed blessing. The possibility of inoculating the recipient with the virus of infectious hepatitis has been emphasized recently (1, 8) and attention called to this serious hazard.

A nitrogen balance study by my associate, Dr. Arnold Kremen and myself yields data illustrating some of the problems and limitations of parenteral alimentation discussed earlier. The final 5 day period of this study is probably a significant example of the body's greater inclination to accept and retain nitrogen when supplied orally rather than intravenously. As has been indicated, the surgeon will find a knowledge of nutrition a means of improving his care of those patients suffering from a recent serious weight loss. Failure to recognize this obligation and meet the augmented nutritional requirements of this group will be followed by an increase in the morbidity and mortality statistics. To avoid these complications, liquid diets augmented with protein rich materials are recommended whenever the oral route is available. For those patients requiring parenteral feeding a specific program, albeit a less satisfactory one, is offered.

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# COMPLETE OCCLUSION OF THE ABDOMINAL AORTA

Report of Two Patients Diagnosed by Aortography

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Philadelphia, Pennsylvania

**I**N 2 patients with complete aortic block just below the origin of the renal arteries diagnoses were made during life by direct translumbar aortic injection of radiopaque medium. In 1 patient, the diagnosis was confirmed by 2 subsequent aortograms, while the other was proved at necropsy. The technique used has been described (8-10).

## CASE REPORTS

**Case 1.** T. H., a white man aged 43 years was admitted to Jefferson Hospital on February 8, 1945 with the chief complaint of pain in both ankles. He had been well until October, 1944, at which time he began to experience progressively increasing weakness of both legs with easy fatigability and pain behind the knees on effort.

On December 7, 1944, while eating supper, he had a violent periumbilical pain so severe that he came doubled up and broke out in a cold sweat. The pain remained localized to the periumbilical area lasted for 1 hour and was followed by a dull ache which persisted for several days. He was admitted to another hospital. The gastric analysis was normal and a ray study of the upper gastrointestinal tract revealed a small deformity at pyloric end of stomach suggestive but not conclusive of a small ulcer.

While in the hospital 5 days after the first acute episode of pain he experienced a sudden right foot ache and thigh then spread upward to the lower leg and finally down the other leg. The attack which lasted about 30 minutes, was accompanied by numbness, paralysis and extreme pallor of both lower extremities. The severe pain then subsided to a dull ache and localized in both ankles. Sensation and motor power returned promptly.

Following discharge from a hospital the patient experienced an almost constant ache in both ankles. The pain usually prevented sleep and necessitated sitting on the edge of the bed with his feet resting on a chair. At the time of admission to Jefferson Hospital he could not take more than 20 steps without experiencing pain in the calves.

From the Department of Medicine and the Samuel D. Gross Surgical Division, Jefferson Medical College Hospital, presented in the forum on Fundamental Surgical Problems, before the Clinical Course of the American College of Surgeons, Philadelphia, on 3, December 6, 1945.

One feature of the occupational history of possible importance was his employment in a cold storage room from 1941 to 1943 during which time he was intermittently exposed to low temperatures.

The patient was thin, weighed 135 pounds and appeared 50 years old. Blood pressure was normal. Respirations were normal. The temperature pulse and obtainable in the lower extremities, but in the left arm was 170/120 and in the right arm 160/120. Eyegrounds showed diffuse arteriolar constriction with increased tortuosity several pinpoint hemorrhages and one large hemorrhage in the extreme periphery of the left eye ground. The remainder of the examination of the head as well as the neck and chest, was essentially normal. The aortic pulsations could not be palpated. Arterial pulsations including the femoral, popliteal, posterior tibial and dorsalis pedis, were not palpable in either lower extremity. Both feet were cold the left colder than right.

The erythrocyte count was 4,400,000 hemoglobin 87 per cent, leukocytes 19,400. Hematocrit, sedimentation rate was normal. Results of repeated urine tests were negative. The blood sugar, urea, nitrogen, uric acid and serum proteins were normal. The urea clearance test was 105 per cent. Tests of prothrombin time in both arms and both legs revealed hypercoagulability as well as circulatory pressure in the upper extremities as well as circulatory time performed by the electrocardiogram showed a prominent Q-wave in leads II and III suggesting a coronary artery disease posterior in type.

Roentgenograms of the chest, abdomen and spine were essentially normal. Soft tissue examination of the lower extremities failed to show any evidence of calcification in the blood vessels. Study of the upper gastrointestinal tract with barium revealed thickened mucosal folds and slight distortion of the duodenal bulb suggestive of an old healed duodenal ulcer and the barium enema was normal.

Circulatory function was impaired in the lower extremities. All indicated markedly impaired function. Skin surface temperature studies failed to show an appreciable rise after paravertebral lumbar sympathetic nerve block. Peritoneoscopy revealed no evidence of an abdominal mass as a source of extrinsic aortic pressure. The left internal iliac artery and vein were

volumes are being employed but attains real significance (9 grams in 6000 cubic centimeters of 5 per cent solution) when large volumes are in use. This item becomes even more important in the presence of the hypoalbuminemia frequently present in just this type of patient. States of overhydration due to such liberal administrations of salt, and serious enough to require temporary cessation of this therapy have been noted.

This listing of these limitations should not be construed to mean that the intravenous administration of protein hydrolysates is fruitless, for no one can seriously contend but that it has an important rôle in nitrogen replacement therapy. Rather it is hoped that the recapitulation of such inherent defects will bring their existence to the attention of those who have not so far appreciated them. Fortunately the number of cases wholly dependent on parenteral feeding is in a minority. Such patients must be blessed with the services of conscientious house officer or interne because they demand of him and themselves an abundant patience and tact during the tedious hours of prolonged intravenous therapy. Without actually achieving the goal of large scale plasma protein regeneration those benefits which result from the employment of hydrolysates are certainly real and definitely worthwhile. Through their agency it is possible to halt or retard the steady protein losses from starvation and allied depleting mechanisms (ulceration infection hemorrhage). The nitrogen intake can also be augmented considerably by daily transfusions of plasma or whole blood. Although the total amount of nitrogen in a plasma or whole blood transfusion would be relatively small considered as dietary or hydrolysate nitrogen it is proportionately more valuable because a significantly smaller fraction is lost in the urine the 24 hours after administration. This situation is particularly true when comparison is made with hydrolysate nitrogen. In this connection it appears only fair when calculating the cost of such replacement therapy to base one's ultimate conclusions on the amount of nitrogen the body actually retains and has available for functional purposes, rather than considering solely the price of each intravenous flask

and its contents. The use of whole blood and plasma, particularly when the latter is from a pooled source, is assuredly not an unneeded blessing. The possibility of inoculating the recipient with the virus of infectious hepatitis has been emphasized recently (18) and attention called to this serious hazard.

A nitrogen balance study by my associate Dr. Arnold Kremen and myself yields data illustrating some of the problems and limitations of parenteral alimentation discussed earlier. The final 5 day period of this study is probably a significant example of the body's greater inclination to accept and retain nitrogen when supplied orally rather than intravenously. As has been indicated, the surgeon will find a knowledge of nutrition a means of improving his care of those patients suffering from a recent serious weight loss. Failure to recognize this obligation and meet the augmented nutritional requirements of this group will be followed by an increase in the morbidity and mortality statistics. To avoid these complications, liquid diets augmented with protein rich materials are recommended whenever the oral route is available. For those patients requiring parenteral feeding a specific program albeit a less satisfactory one, is offered.

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# COMPLETE OCCLUSION OF THE ABDOMINAL AORTA

Report of Two Patients Diagnosed by Aortography

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**I**N 2 patients with complete aortic block just below the origin of the renal arteries diagnoses were made during life by direct translumbar aortic injection of radiopaque medium. In 1 patient, the diagnosis was confirmed by 2 subsequent aortograms while the other was proved at necropsy. The technique used has been described (8, 10)

## CASE REPORTS

**Case 1:** T. H., a white man aged 43 years was admitted to Jefferson Hospital on February 8, 1945 with the chief complaint of pain in both ankles. He had been well until October, 1944 at which time he began to experience progressively increasing weakness of both legs with easy fatigability and pain below the knees on effort.

On December 7, 1944 while eating supper he had a violent periumbilical pain so severe that he came doubled up and broke out in a cold sweat. The pain remained localized to the periumbilical area lasted for 1 hour and was followed by a dull ache which persisted for several days. He was admitted to another hospital. The gastric analysis was normal and a x-ray study of the upper gastrointestinal tract revealed a small deformity at pyloric end of stomach suggestive but not conclusive of a small ulcer.

While in the hospital 5 days after the first acute episode of pain he experienced a sudden attack of excruciating pain which first involved his right foot, leg, and thigh then spread upward to the lower abdomen and finally down the other leg. The attack which lasted about 30 minutes, was accompanied by numbness, paralysis, and extreme pallor of both lower extremities. The severe pain then subsided to a dull ache, and localized in both ankles. Sensation and motor power returned promptly.

Following discharge from the hospital, the patient experienced an almost constant ache in both ankles. The pain usually prevented sleep and necessitated sitting on the edge of the bed with his feet resting on a chair. At the time of admission to Jefferson Hospital he could not take more than 20 steps without experiencing pain in the calves.

From the Department of Medicine and the Samuel D. Gross Surgical Division, Jefferson Medical College Hospital. Presented in the forum on Fundamental Surgical Problems, before the Clinical Congress of the American College of Surgeons, Cleveland, Ohio, December 6-20, 1946.

One feature of the occupational history of possible importance was his employment in a cold storage room from 1941 to 1943 during which time he was intermittently exposed to low temperatures.

The patient was thin, weighed 135 pounds and appeared 50 years old. The temperature was unobtainable in the lower extremities but in the right arm was 170/120 and in the right arm 160/120. Eyegrounds showed diffuse arteriolar constriction with increased tortuosity several pinpoint hemorrhages and one large hemorrhage in the extreme periphery of the left eye ground. The remainder of the examination of the head as well as the neck and chest was essentially normal. The aortic pulsation normal except for the fact that aortic pulsation could not be palpated. Arterial pulsations including the femoral, popliteal, posterior tibial and dorsalis pedis were not palpable in either lower extremity. Both feet were cold, the left colder than right.

The erythrocyte count was 4,400,000, hemoglobin 87 per cent, leucocytes 7,400 with normal sedimentation rate was normal. Results of repeated urine tests were negative. The blood Wassermann and Kahn reactions were negative. The blood sugar, urea nitrogen, uric acid and serum proteins were normal. The urea clearance test was 105 per cent. The prothrombin time was 100 per cent and tests of venous clotting time in both arms and both legs revealed hypercoagulability of the blood. Venous pressure in the upper extremities as well as circulatory time performed by the calcium gluconate method were normal. The electrocardiogram showed a prominent Q-wave in leads II and III suggesting coronary artery disease posterior in type.

Röntgenograms of the chest, abdomen and spine were essentially normal. Soft tissue examination of the lower extremities failed to show any evidence of calcification in the blood vessels. Study of the upper gastrointestinal tract with barium revealed thickened mucosal folds and slight distortion of the duodenal bulb suggestive of an old healed duodenal ulcer and the barium enema was normal.

Circulatory function tests in the lower extremities all indicated markedly impaired function. Skin surface temperature studies failed to show an appreciable rise after paravertebral lumbar sympathetic nerve block. Pentonoscopes revealed no evidence of an abdominal mass as a source of extrinsic aortic pressure. The left internal iliac artery and vein were





Fig. 1. First aortogram in Case 1 showing complete transverse block of abdominal aorta at level of middle of second lumbar vertebra.

clearly visualized but no arterial pulsation was noted. A neurosurgical consultant reported normal neurologic findings and advised that lumbar sympathectomy would be of questionable value.

Massive obstruction in the iliac arteries and the aorta itself was thought the most likely possibility but coarctation of the aorta was also considered. It was felt that aortography might definitely prove the diagnosis. Accordingly this procedure was first performed on February 24, 1945, with aortic puncture at the level of the upper border of the first lumbar vertebra. The arteriogram revealed a complete transverse block of the aorta at the level of the middle of the second lumbar vertebra immediately below the origin of both renal arteries (Fig. 1). The renal arteries and their tributaries were well visualized and appeared normal. In order to rule out any errors in technique repeat aortography was performed on April 30, 1945, puncture being made one vertebral level lower, at the upper border of the second lumbar vertebra. On this aortogram (Fig. 2) practically all of the radiopaque medium was visualized within the superior mesenteric artery and its branches, and no portion of the aorta itself was definitely delineated. Anastomosis of the middle colic branch of the superior mesenteric artery with the left colic branch of the inferior mesenteric was well demonstrated on this examination. Since the second



Fig. 2. Second aortogram in Case 1 2 months later showing opaque medium within superior mesenteric artery and its branches. Arrow indicates large anastomotic communication between middle colic artery of the superior mesenteric and left colic branch of inferior mesenteric artery.

aortogram merely confirmed the findings of the first one by inference rather than actual demonstration of the block, the study was performed for the third time on June 4, 1945. The needle was introduced at the level of the second lumbar vertebra just above the area of anticipated block. This aortogram (Fig. 3) left no doubt as to the existence of the block, which was sharply delineated at precisely the same level as on the first examination. The large anastomotic channel between the superior and inferior mesenteric arteries was again visualized as well as an extensive paravertebral anastomosis.

*Treatment and subsequent course.* Anticoagulation therapy with dicoumarol vasodilator drugs (papaverine and niacinamide, sodium citrate and sodium tetrathionate intravenously; and mebrohyl by iontophoresis) and the oscillating bed were employed during his 6 1/2 months in the hospital. One month after admission the patient developed an ischemic ulcer on the lateral aspect of the right leg just above the external malleolus (Fig. 4a). Despite the use of penicillin systemically, various local applications including blood ointment and the measures already mentioned to improve the arterial circulation in his lower extremities, the ulcer remained refractory throughout his hospital stay. He



Fig. 3. Third aortogram in Case 1, 3 months after first aortography showing sharp delineation of the block just below the origin of the renal arteries. An extensive para vertebral anastomosis is demonstrated.

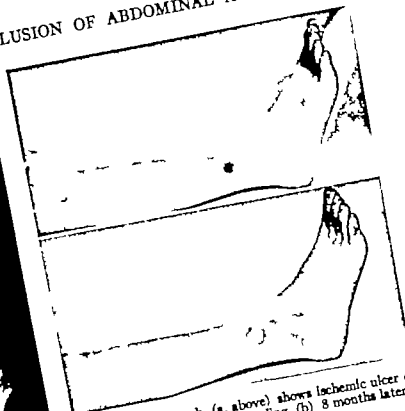


Fig. 4. Photograph (a, above) shows ischemic ulcer of leg in Case 1 with complete healing. (b) 8 months later.

was discharged on August 22, 1945. At this time he could walk about 50 steps before experiencing pain in the calves, and he was also able to sleep most of the night without pain in the ankles.

Three months after the patient left the hospital his leg ulcer healed (Fig. 4b) after having been present for 8 months. Follow up examination was last performed on November 26, 1946, a year and 3 months after discharge. At this time the patient stated he felt well, could walk three city blocks without having to stop because of pain, and could do light work. Blood pressure in the left arm was 210/150 in the right arm 200/150 but unobtainable in the lower extremities. Aortic pulsation could not be detected and arterial pulsations in the lower extremities were still not palpable.

CASE 2. J. D., a white man aged 52 years, was admitted to Jefferson Hospital on February 19, 1945, with the chief complaint of frontal headaches. These headaches, which first arose in the morning and occurred when the patient arose in the day, became progressively worse during the day. A physician could be relieved by rest and salicylate medication. In January 1943, he was informed by a physician that he had albuminuria and a systolic blood pressure of 260. Despite treatment by doctor, he had almost daily frontal headaches with occasional dizziness.

During the preceding 10 years the patient had experienced numbness, tingling, and weakness of the lower extremities particularly after prolonged effort but never any pain. He was treated for pneumococcal pneumonia in February 1943 in another hospital. The family history was not significant.

The patient was a middle-aged thin man weighing 118 pounds, lying comfortably in bed. The temperature pulse and respirations were normal. Blood pressure in the left arm was 250/130, right arm 210/130, left thigh 124/100, and right thigh 130/108. Ophthalmoscopic examination revealed diffuse hypertensive retinitis with arteriosclerosis grade 3. The remainder of the examination of the head as well as the neck and lung fields were essentially normal. The heart was regular in rate, force, and rhythm, slightly enlarged to the left, and there were low grade systolic murmurs at all the valve areas. There was a palpable aortic impulse in the epigastrium over which a systolic murmur was audible but no pulsations could be detected below this area. The remainder of the abdominal examination was normal. Examination of the extremities revealed a full strong radial pulse but arterial pulsations, including femoral, in the lower extremities were almost imperceptible.

The blood count revealed the hemoglobin to be 98 per cent, erythrocytes 5,000,000 and leucocytes 9,800 with normal differential count. The blood sedimentation rate was not increased. The blood Wassermann and Kahn reactions were negative. Repeated urinalyses revealed moderate albuminuria. The highest urine specific gravity was 1.008. The urea clearance test was 64 per cent and the phenolsulfonphthalein dye test revealed 25 per cent.



Fig. 5. Aortogram in Case 1 showing complete block at precisely the same level as in Case 2. Arrow indicates huge anastomotic channel between middle colic and left colic arteries as in Figure 2.

renal excretion in one half hour. The blood urea nitrogen was 20 milligrams. The venous pressure in the arm was 15 millimeters and the circulation time 12 seconds. The electrocardiogram suggested coronary artery insufficiency anterior in type.

A roentgenogram of the chest revealed emphysematous lung fields and a cardiac silhouette within normal limits. There was no notching of the ribs as might be expected with aortic coarctation. X-rays of abdomen and intravenous urogram were normal.

In spite of complete bed rest, sedation and salt poor diet the patient showed no improvement. Even with sodium amylal narcosis there was no appreciable decrease in hypertension. On March 7, 1945 the patient signed his own release. It was felt that the probable diagnosis was coarctation of the aorta.

The patient was readmitted on March 23, 1945 with the same complaints. The physical examination revealed no significant changes since the last admission. Blood pressure in the left arm was 136/130 right arm, 100/110 left thigh 130/90 and the right thigh 120/90. The blood count and urinalysis revealed essentially the same findings as before. The sedimentation rate was still normal. Another intravenous urogram revealed ptosis of the left kidney.

Because the clinical picture simulated coarctation of the aorta and because roentgenograms of the chest

failed to confirm this belief it was felt that aortography might reveal the exact nature of the lesion. Accordingly this was done on March 23, 1945 puncture being made at the lower border of the twelfth thoracic vertebra. The aortogram (Fig. 5) revealed a sharply defined complete transverse block at the level of the middle of the second lumbar vertebra, just below the origin of the renal arteries. No dye was visualized in the iliac arteries or lower portion of the abdominal aorta. A large anastomotic communication between the middle colic branch of the superior mesenteric artery and left colic branch of inferior mesenteric was well delineated as in Case 1.

The day following aortography the patient was discharged as unimproved.

Following the second discharge the patient went back to his usual work as a waiter. Except for headaches and mild dyspnea on exertion he was able to work until January 28, 1946. At this time he experienced moderately severe substernal pain, radiating down the left arm, accompanied by dyspnea. These symptoms became severe on February 2, 1946 and on February 4 he was admitted to the hospital.

The patient was orthopneic, cyanotic, dehydrated, and poorly nourished. He was drowsy but oriented and co-operative. The temperature was 100° degrees F, pulse 120 and respirations, 36. The blood pressure was 60/110 in the right arm but unobtainable in lower extremities. There were moist rales at both bases but heart sounds were strong; no murmurs noted. There was moderate abdominal distention.

Blood count revealed a hemoglobin of 125 per cent, erythrocytes 5,400,000, leucocytes 14,000 with 90 per cent neutrophils, and 10 per cent lymphocytes. Urinalysis revealed occasional granular casts but was otherwise normal. The sedimentation rate was not increased. The blood nonprotein nitrogen was 75 milligrams and carbon dioxide combining power 20 volumes per cent. The electrocardiogram showed changes indicating an acute anterior coronary occlusion with involvement of a large posterior branch. The patient became progressively more dyspneic and died 33 hours later. During this final admission he voided only 200 cubic centimeters of urine.

Postmortem examination was performed by Dr. Peter A. Herbut. The salient gross pathologic findings were generalized arteriosclerosis, bilateral pleural adhesions, pulmonary congestion and edema, terminal pneumonia, cardiac hypertrophy, atherosclerotic thrombosis of the abdominal aorta both old and recent, and bilateral polar renal vessels. The heart, aorta, and kidneys were of the greatest interest and the findings in these are given in some detail.

The heart weighed 555 grams. The pericardial and endocardial surfaces were smooth and glistening. The myocardium was firm, hypertrophied and reddish brown. There was no definite evidence of old or recent infarction. The valves were normal in number, size, shape, and position. Coronary ostia patent, and vessels showed moderate atherosclerosis.

The thoracic aorta showed moderate atherosclerosis with several plaques. The abdominal aorta

showed a complete thrombotic occlusion extending from the renal vessels to the common iliac vessels (Fig 6). The proximal 5 centimeters of the thrombus extending equidistant above and below the upper renal vessels, was recent, dark red friable, and only moderately adherent to the wall of the aorta in places. The portion extending from the lower renal vessels to the common iliacs including the proximal 4 centimeters of the right common iliac was dense grayish white, fibrous, firmly adherent and continuous with the wall of the aorta.

The kidneys weighed 130 grams each and measured approximately 12 by 7 by 5 centimeters. The capsules stripped with ease. The external and cut surfaces were deep reddish brown and the demarcations were sharp. There were 2 renal vessels to each kidney (Fig 6). The upper renal vessels were 4 to 5 centimeters in length 7 to 8 millimeters in diameter and patent. The lower renal vessels were 4 to 5 centimeters in length 2 to 3 millimeters in diameter and occluded. The pelvis and ureters were normal.

The salient histologic findings were pleural fibrosis, pulmonary congestion and edema, terminal pneumonia, myocardial fibrosis, atherosclerosis and thrombosis of the abdominal aorta, and benign nephrosclerosis.

Histologic sections of the lower portion of each kidney disclosed only slight ischemic atrophy. Sections through the upper portion showed severe congestion severe arterial and arteriolar sclerosis hyalinization of the glomeruli proliferation of the glomerular epithelium and occasional necrosis of glomerular tufts. Sections of abdominal aorta at level of injection for aortography showed no changes that could be attributed to needle puncture.

#### DISCUSSION

Visualization of the level and degree of arterial obstruction as well as the amount of collateral circulation following thrombosis and embolism is possible by means of arteriography. Although employed for this purpose in selected instances in the peripheral arteries (9) arteriography for diagnosis of aortic lesions has been practically neglected. According to a review of the literature on thrombosis and embolism of the abdominal aorta by Greenfield in 1943 there were 161 cases on record and in none of these was aortography done to establish the diagnosis during life.

Blakemore (1) produced total occlusion of the aorta just distal to the renal arteries by wiring and electrothermic coagulation of a syphilitic aneurysm in this location. He then performed aortography by direct injection of 70 per cent diodrast solution into the lower thoracic aorta. The roentgenogram which un-

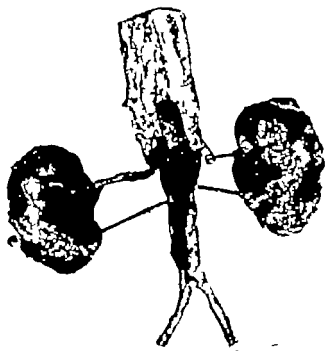


Fig 6 Postmortem specimen of aorta and kidneys in Case 2 showing old thrombus below renal arteries and recent thrombus above renal arteries. Note bilateral polar renal arteries. Death occurred 10 months following aortography.

fortunately was poor because of motion by the patient, nevertheless revealed radiopaque medium within both renal arteries one very large collateral artery going down the right side posteriorly opacification of the aneurysm and lack of visualization of the aortic bifurcation as evidence of complete obstruction. Farnas (3, 4) by means of retrograde abdominal aortography has demonstrated partial and complete occlusion of the aortic cone. So far as we are aware these represent the only previous reports of aortography in thrombotic occlusion.

It is interesting that, although the level of the block was identical in our 2 patients and both had hypertension the symptomatology was different. In the first patient, the symptoms centered about the diminished supply of blood to the lower extremities while in the second the symptoms were principally related to the hypertension. In both symptoms were slow in onset suggestive of a gradually narrowing process, but in the first the acute pain evidently represented completion of occlusion. Collateral blood supply to the lower extremities in this condition is mainly by anastomosis



Fig. 5. Aortogram in Case 2 showing complete block at precisely the same level as in Case 1. Arrow indicates huge anastomotic channel between middle colic and left colic arteries as in Figure 1.

renal excretion in one half hour. The blood urea nitrogen was 20 milligrams. The venous pressure in the arm was 5 millimeters and the circulation time 12 seconds. The electrocardiogram suggested coronary artery insufficiency anterior in type.

A roentgenogram of the chest revealed emphysematous lung fields and a cardiac silhouette within normal limits. There was no notching of the ribs as might be expected with aortic coarctation. X-rays of abdomen and intravenous urogram were normal.

In spite of complete bed rest, sedation and salt poor diet the patient showed no improvement. Even with sodium amytal narcosis there was no appreciable decrease in hypertension. On March 7, 1945 the patient signed his own release. It was felt that the probable diagnosis was coarctation of the aorta.

The patient was readmitted on March 22, 1945 with the same complaints. The physical examination revealed no significant changes since the last admission. Blood pressure in the left arm was 236/130, right arm 200/120, left thigh 130/90 and the right thigh 70/90. The blood count and urinalysis revealed essentially the same findings as before. The sedimentation rate was still normal. Another intravenous urogram revealed ptosis of the left kidney.

Because the clinical picture simulated coarctation of the aorta, and because roentgenograms of the chest

failed to confirm this belief, aortography might reveal the cause. Accordingly this was done, the procedure being made at the lower thoracic vertebra. The aorta was sharply defined, complete block just left of the middle of the section just below the origin of the renal artery was visualized in the iliac artery of the abdominal aorta. A large communication between the middle superior mesenteric artery and the inferior mesenteric was well delineated.

The day following aortography the patient was discharged as unimproved.

Following the second discharge the patient went back to his usual work as a waiter. He had no chest pains and mild dyspnea on exertion. He worked until January 28, 1946. At that time he experienced moderately severe substernal pain radiating down the left arm accompanied by numbness. These symptoms became severe on February 2, and on February 4, he was admitted to the hospital.

The patient was orthopneic, cyanotic, dehydrated and poorly nourished. He was drowsy but alert and co-operative. The temperature was 100 F, pulse 120 and respirations, 36. The blood pressure was 160/110 in the right arm but unobtainable in lower extremities. There were moist rales at the bases, but heart sounds were strong, no murmur noted. There was moderate abdominal distention.

Blood count revealed a hemoglobin of 12.5 per cent, erythrocytes 5,400,000, leukocytes 24,000 with 90 per cent neutrophils and 10 per cent lymphocytes. Urinalysis revealed occasional granular casts but was otherwise normal. The sedimentation rate was not increased. The blood nonprotein nitrogen was 75 milligrams and carbon dioxide combining power 20 volumes per cent. The electrocardiogram showed changes indicating an acute anterior coronary occlusion with involvement of a large posterior branch. The patient became progressively more dyspneic and died 33 hours later. During this final admission he voided only 200 cubic centimeters of urine.

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The thoracic aorta showed moderate atherosclerosis with several plaques. The abdominal aorta



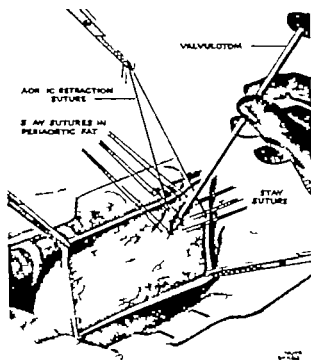


Fig. 1 Introduction of valvulotome into aorta after placing traction ligature around aorta and stay sutures in periaortic fat

by digital pressure over the opening while the traction ligature was held taut thus bringing the exposed portion of the aorta into the wound and immobilizing it. A specially constructed valvulotome was then manipulated gently into the aortic opening and made to impinge upon the posterior wall of the aorta (Fig. 1). In contact with the latter the instrument was passed proximally within the aorta, its sheath tamponading effectively the wound in the aortic wall until its further progress was arrested within a cusp of the aortic valve. The hooked blade next was forced out of the sheath perforating the cusp in its dependent portion then the valvulotome withdrawn thus dividing the free margin of leaflet (Fig. 2). In this maneuver the instrument was withdrawn as a whole without pulling the blade back into its sheath. Upon withdrawal of the valvulotome hemorrhage the opening in the aorta immediately be-

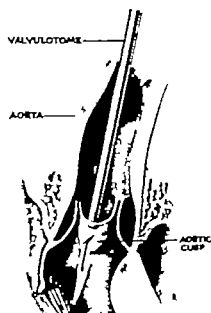


Fig. 2 Schematic representation of longitudinal section of aorta showing perforation of valve leaflet. Withdrawal upward of barbed blade divides free margin of cusp.

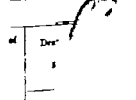
a problem of considerable magnitude. Its control was attempted by two methods. At the beginning of the experimental studies, closure of the defect by interrupted fine silk sutures placed in the aortic wall was the method employed. This resulted in a high mortality due to failure of the sutures to hold with tearing of the wall thus increasing the size of the wound to such an extent that uncontrollable hemorrhage ensued (Table II). The second procedure was found to be more effective. It consisted of digital tamponade of the bleeding point until the previously placed stay sutures or pursestring suture in the periaortic fat could be tied over an absorbable gelatin sponge which was manipulated beneath the

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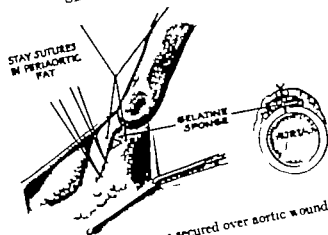


Fig. 3. Gelatin sponge secured over aortic wound by fat sutures.

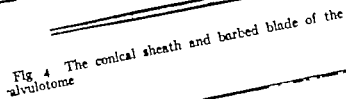


Fig. 4. The conical sheath and barbed blade of the valvulotome

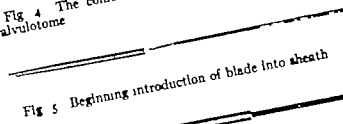


Fig. 5. Beginning introduction of blade into sheath

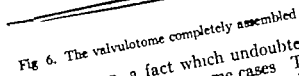


Fig. 6. The valvulotome completely assembled

The valvulotome The instrument used in producing the valvular defects consisted of two separate parts the first being an exterior brass sheath of graduated conical shape (Fig 4) the smaller diameter being at the distal end the larger at the proximal end By this arrangement tamponading of the aortic opening occurred as the distal end of the instrument was introduced into the aorta The second part of the instrument consisted of a barbed blade attached to the end of a long brass handle (Fig 4) The latter upon being introduced into the sheath in the manner of a trocar into a cannula (Fig 5) fitted snugly within the sheath so as to prevent the escape of blood around it The interior of the sheath contained a circumferential ridge near its distal extremity which arrested further progress of the handle so as to permit only the blade to project from the distal end Introduction of the sheath into the aorta was accomplished in each instance with the blade pushed up within the sheath so as not to damage the interior of the aorta during the downward progress of the instrument toward the valve leaflet The blade was thrust out only after the sheath had become engaged within the cusp (Fig 2)

## RESULTS

Twenty two animals were subjected to operation There were 14 survivals and 8 deaths a mortality of 36 per cent (Table I) All deaths occurred either during the operation or immediately thereafter and were due in each instance to severe blood loss from the aortic wound No attempt was made to replace blood

by transfusion a fact which undoubtedly influenced the outcome in some cases Table II summarizes the comparative mortality according to techniques employed to control hemorrhage from the aortic opening In the first 7 animals operated upon stay sutures of fine silk were placed directly in the wall of the aorta instead of in the periaortic fat Five of these animals died of hemorrhage because the sutures failed to hold cutting through the aortic wall and producing large rents which grew larger as further efforts at direct closure by suturing were made Fifteen animals were operated upon with only 3 deaths (Table II) using the combination of periaortic fat suture and gelatin sponge tamponade of the bleeding point A pursestring suture in the fat was found to be superior to interrupted stay sutures The 3 deaths in the group treated by the fat suture-gelatin sponge technique resulted from hemorrhage incident to one or both of two factors slipping of the sponge from its proper location during closure of the overlying fat and accidental enlargement to an unmanageable extent of the valvulotome during introduction of the valvulotome

TABLE III — VALVULAR LESIONS PRODUCED IN SURVIVING ANIMALS

Surviving animals
Perforation of cusp
Division of cusp
Absence of lesion
Successful results, per cent
Failures, per cent



operation. Valvular lesions were found in 12 animals (86%). In 2 animals, no evidence of a valvular defect was noted (Table III). In the latter it is likely that the valvulotome failed to become engaged in a leaflet passing instead into the ventricular chamber during systole. Perforation or laceration of a cusp occurred in 8 animals while in only 4 animals was complete division of the free margin of the leaflet produced (Table III).

#### DISCUSSION

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of adequate collateral circulation. The factor of time has been similarly emphasized by Matas Holman and by Pemberton and Black (36) Gilkin and many others.

It should be pointed out however that an arteriovenous communication acts entirely differently from other types of vascular lesions, which usually cause more or less obstruction with a resulting rise in resistance to the flow of blood through the affected vessels. In an arteriovenous fistula, on the other hand the blood in the arterial system on arriving at the fistula, enters a region of markedly reduced resistance and flows directly into the vein where its distal movement is obstructed by valves, by the decreasing caliber of the vessels and by elevated venous pressure. The blood consequently returns immediately to the right side of the heart thus by passing the distal arteriolar and capillary beds. The shunting of the arterial blood when sufficiently great, obviously deprives the distal tissues of the involved part of adequate nutrition and stimulates compensatory responses. To quote Holman (22) "All avenues of approach to the fistula open up to appear as it were the thirst of the fistula." As stated in the preceding paragraph, one important factor in disrupting normal vascular physiologic processes in a part distal to an arteriovenous fistula is the rise of venous pressure. It is obvious that the arterial blood, under a tension of more than 100 millimeters of mercury on entering the venous system via the fistula will cause an elevation of the venous pressure which by contrast normally may be measured as a few centimeters of water. The mechanical obstructions to distal venous flow of this arterial blood mentioned previously are effective in diverting the greater part of the flow proximally toward the heart. This increase of volume flow and pressure results in a

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As stated in the first part of this important fact, the physiological response to an arteriovenous fistula is a decrease in the arterial pressure. It is considered a tense mercury manometer pressure in the fistula will be a measure of the mechanical pressure of this pressure are effective in the flow of blood.

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As stated in the preceding paragraph, one important factor in disrupting normal vascular physiologic processes in a part distal to an arteriovenous fistula is the rise of venous pressure. It is obvious that the arterial blood, under a tension of more than 100 millimeters of mercury on entering the venous system via the fistula will cause an elevation of the venous pressure which by contrast normally may be measured as a few centimeters of water. The mechanical obstructions to distal venous flow of this arterial blood, mentioned previously, are effective in diverting the greater part of the flow proximally toward the heart. This increase of volume flow and pressure results in a

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compensatory dilatation which is demonstrable in the centripetal venous channels as well as the right side of the heart. Distally in the extremity this elevated venous pressure also hinders circulation from collateral vessels that otherwise would be much more effective.

The presence of a region of markedly elevated venous pressure at the fistula serves to act as a block to the venous outflow of the distal parts by virtue of the pressure differential as well as the effect of keeping the distal valves in the veins shut. Since the normal direction of the arterial systolic thrust is centrifugal there is maintained a constant piston like force on the distal venous tree so that eventually as a result of the distention of the vessels and the direct pressure on the cusps, the valves may become incompetent. The magnitude of this effect depends primarily on the duration, size and location of the fistula. Secondary to this interference with normal venous drainage is an increase of the intercellular fluid and lymph. The scarring about a traumatic fistula may block some of the major lymphatic channels and thus contribute to the formation of edema.

Hence in the presence of a fistula, the distal parts are frequently deprived more effectively of a normal circulation than following actual ligation of the major artery or arteriectomy. That the so-called collateral circulation is unable to provide an adequate blood supply to the tissues is evidenced by the frequent occurrence of trophic alterations in the distal parts. Trophic changes are seen as well in persons who have congenital arteriovenous fistulas even when the maximal time for development of collateral circulation has elapsed. While gangrene is relatively rare following closure of an arteriovenous fistula in the lower extremity there is a high incidence of vascular insufficiency particularly in the aged which is manifested by chronic edema, intermittent claudication, case of fatigue, sensation of heaviness and paresthesias. This was noted by Bigger who saw in his postoperative cases definite evidence that circulation is inadequate for sustained muscular activity. This is an important matter and one which has not received the attention which is its due. Other authors have seen fit to question the value of this type

of vascular response. La Roque in 1921 expressed the opinion that there was "much reason for believing that the development of circulation is antagonized by arteriovenous fistula." Elkin (8) in 1943 similarly pointed out the possible inadequacy of this collateral circulation when he said that this great collateral circulation was for the most part useless since the blood returns to the heart without nourishing the distal parts. Recently Freeman has called further attention to the vascular deficiency which may follow the surgical repair of arteriovenous fistulas. In the March 8, 1947 issue of the *Journal of the American Medical Association* Henningman, Rives and Davis reviewed the results of the various operative procedures employed in a series of 33 cases of arteriovenous fistula. Local vascular insufficiency did not develop in any of the 8 patients treated by a restorative procedure whereas a third or more of those patients having an obliterative procedure suffered subsequently from the symptoms of vascular deficiency.

The acceptance by so many surgeons of the concept that great collateral circulation develops with time generally has resulted in a delay of 3 to 6 months in the treatment of arteriovenous fistulas. Consequently we were stimulated to attempt to determine the actual effective arterial collateral circulation present in a limb which had had a fistula functioning for periods of time up to one year. Further more, because of the claim of some investigators that attempts to improve collateral circulation (after time enough has elapsed for it to have developed) are foolhardy if not actually contraindicated an investigation was made of the cutaneous temperature in the limb distal to a long standing arteriovenous fistula, both before and after lumbar sympathetic gangliectomy.

#### I. DEMONSTRATION OF COLLATERAL CIRCULATION IN A LIMB IN WHICH THERE IS A CHRONIC ARTERIOVENOUS FISTULA

**Method.** In 19 adult dogs under ether anesthesia, lateral arteriovenous fistulas were made, in the femoral vessels, 1 to 2 centimeters below the profundus branch of the artery by the suture method (7). The communication between the artery and the vein ranged from 1.5

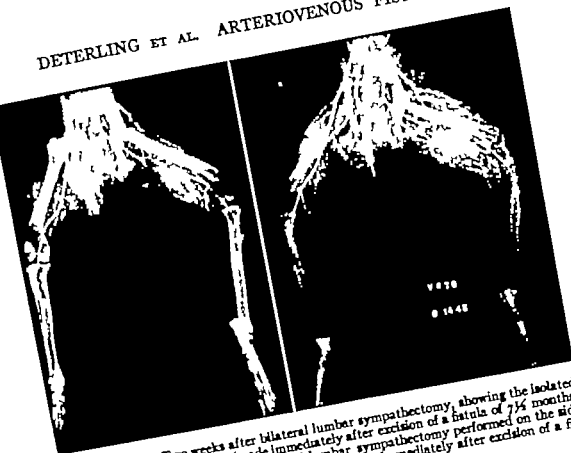


Fig. 3. a, left, Two weeks after bilateral lumbar sympathectomy, showing the isolated arterial collateral circulation (made immediately after excision of a fistula of 7½ months' duration). b Two weeks after unilateral lumbar sympathectomy performed on the side of the fistula (left). In this case the picture was taken immediately after excision of a fistula of 7½ months' duration.

isolated arterial tree with the complete arteriovenous bed.

**Group III Method.**—The legs of the 4 remaining animals of series A were perfused in the usual manner and the fistula was dissected free. Carrel clamps were placed on the proximal and distal vessels to occlude the arteriovenous communication effectively. Injection was then carried out and roentgenograms of the isolated arterial circulation were made. Later the clamps were released and the injection of the barium mass was completed as in group I. Roentgenograms were again taken.

**Results.**—This set of experiments showed clearly the paucity of arterial collateral circulation compared with the total vascular bed in the region of the fistula (Fig. 2a and b) in the same animal. A differential study of this kind in a group of animals having comparable fistulas of varying duration makes possible an understanding of the rate of development of the vascular changes. It is evident that the arterial response appears very rapidly reaching its maximal development early while the augmentation of the venous system is gradual, occurring during a period of many weeks.

**Series B Method.**—The remaining 7 animals were also used in a study of the effect of lumbar sympathetic ganglionectomy on blood flow and cutaneous temperature. In 4 animals, bilateral lumbar ganglionectomy was performed and in 3 the ganglionectomy was restricted to the side of the fistula. In all the animals, the arteriovenous communication had been active for about 7 months before sympathectomy. In this series the fistula was excised 2 weeks after sympathectomy (a) to demonstrate further the isolated arterial system as an entity and (b) to show any effect on this system that sympathectomy might have had. Immediately after the quadruple ligation and excision of the fistula, the injection of the isolated arterial tree was carried out as described for group II.

**Results.**—Roentgenograms were made of the lower arterial vascular bed of the sympathectomized animals after perfusion and injection. In the group on which bilateral lumbar ganglionectomy had been performed 2 weeks previous to the excision of the fistula there was a minor degree of vasodilatation and tortuosity of the small arteries just distal to





Fig. 2. a, left, Isolated arterial collateral circulation after occlusion of the abnormal communication with Carrel clamps. b. The same animal after removal of the clamps and completion of the injection with the fistula patent. This indicates that the predominant vascular response has been venous.

crease of venous pressure and blood flow. This

'Medusa's head' in the region of the fistula is what many authors have referred to when they described the collateral circulation of an arteriovenous fistula. This is also an example of what one sees in a clinical angiogram of this type of lesion for the patent communication allows the contrast medium to fill the entire network of vessels and permits identification of the fistula. It must be realized that a clear picture of the arterial circulation is necessary to evaluate collateral circulation. Any obliterative surgical procedure will close the communication between the artery and the vein, and consequently exclude the dilated venous vessels from the collateral vascular supply. To demonstrate the isolated arterial bed, the following procedure was used.

**Group II. Method.**—In 4 animals the perfusion with Ringer's solution was carried out as described. The fistula was then exposed by cautious dissection without sacrifice of any major collateral vessel. The proximal artery and vein were identified and ligated adjacent to the site of the fistula. The distal vessels were similarly ligated and the fistula was excised. In all instances the arteriovenous com-

munication had been patent up to the time of closure. Injection was then carried out to demonstrate the arterial system alone.

**Results.**—In this series, a representation of the venous response to the presence of a chronic arteriovenous fistula was eliminated completely by excision of the fistula. The injected vessels represented only the arterial channels in the limb. These in turn were the true collateral circulation or that part of the circulation which would function after surgical closure of the fistula (Fig. 1b). The marked contrast in the appearance of the vessels before and after closure of the arteriovenous fistula cannot be overemphasized. However it must be admitted that there was a marked difference in the appearance of the injected vascular beds of successive animals. In some of the animals, except for the region from which the fistula had been excised, the arterial tree was approximately the same in the control limb as in that with the fistula. On the other hand, a number of animals that had fistulas of the same size and duration had a definite augmentation of arterial circulation just distal to the fistula. With such variation possible, it was therefore necessary to compare in the same animal the



the region of the aneurysm (Fig 3a). This was seen also in the series without sympathectomy and represents the degree of arterial response primarily as a result of time. As the denervation had been bilateral, there was no significant gross difference in the general vascular bed of both limbs beyond that resulting from the aneurysm alone. The differences of cutaneous temperature of the limbs found are reported farther on in this paper. They were accounted for on the basis of differences in the circulation supplying the limbs.

In the animals which had sympathectomy only on the side of the fistula, there was a slight increase in diameter of the vessels on the denervated side over that of the control side. In all these animals, the greatest apparent increase was in the region just distal to the excised fistula (fig 3b) since here there were superimposed the outlines of those many small arteries which had dilated as a result of the aneurysm. However further evidence that the vasodilatation following sympathectomy affected the entire vascular segment will be presented in the section of this report dealing with cutaneous temperature.

*Comment.* A comparison of roentgenograms taken on animals having arteriovenous fistulas of shorter duration than the fistulas of the dogs already considered indicates that the arterial response is rapid requiring only a few days to be significant. This is in agreement with studies on the development of collateral flow by other investigators which have shown most of the channels involved in collateral circulation to be present at the time of an obstruction of a major vessel. The venous component of the circulation resulting from an arteriovenous fistula, on the other hand develops more slowly and relentlessly over a period of weeks or months, and is without beneficial effect on the limb. Concurrent with the local dilatation of the venous bed there are increases of circulating blood volume and cardiac size. Experimentally we have found microscopic evidence that there are pulmonary renal, cardiac and hepatic changes which may or may not be reversible.

On inspection of the arterial collateral circulation developed during a period of more than six months, it is important to note that

the localized region of increased vasculature is actually *distal* to the arteriovenous fistula. It would appear therefore that the small arteries, visualized by injection methods, had been subjected to an excessive function, but in a manner different from the usual collateral channels which develop in response to an obstructive lesion. The tremendous return flow of blood from the fistula toward the heart indicates that the dilated channels in the arterial system have been draining blood into the site of the fistula with its low pressure by diversion of much of the blood which flows normally to the pelvic structures and limb via anastomotic channels of the deep circumflex iliac, internal and external iliac, pudendal, gluteal and lateral sacral vessels among others. One may consider as well the possibility that when reversed venous flow occurs, some of this blood finds itself back in arterial channels, and by retrograde flow again enters the site of the fistula. Consequently with the fistula patent, these channels do not serve to by pass the lesion and act as supplementary vessels as in obstructive vascular lesions. In the latter by contrast, the accessory vessels have their great exit function and are the most numerous in the actual region of obstruction. They arise from the immediately adjacent derivatives of the affected vessels, particularly from the proximal branches. Consequently it is difficult to escape the belief that the arterial collateral circulation in the presence of an arteriovenous fistula may contribute much less to the subsequent viability of the limb after obliterative operation than is ordinarily believed. The rise of cutaneous temperature of the toes observed (5.41) after closure of a more proximal fistula is but a qualitative and not a quantitative index of the increase of distal blood flow. Consequently this rise of cutaneous temperature gives no indication of the actual amount of collateral circulation. That this increase of blood flow may be inadequate is attested by the reports of gangrene and circulatory deficiency following the repair of a fistula.

One would expect the beneficial effects of lumbar sympathetic block on collateral circulation to involve the entire limb in contrast to the response of the vessels to time alone, in which latter case the dilatation would very

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TABLE I — AVERAGE TEMPERATURE GRADIENT OF THE HIND LIMB OF AN ANIMAL HAVING A CHRONIC LEFT FEMORAL ARTERIOVENOUS FISTULA

Site of measurement	Right	Left
	sympathetic ganglionectomy	sympathetic ganglionectomy
a Before bilateral lumbar sympathectomy	37.0° C	37.5° C
Poupart's ligament	37.0	38.5
Thigh	36.0	38.0
Upper third	35.0	37.5
Middle third	33.0	34.5
Lower third	32.5	32.0
Lower leg	32.0	31.0
Ankle	31.5	30.0-30.5
Foot		38.0
Interdigital web	37.5	
b After bilateral lumbar sympathectomy		
Poupart's ligament	37.5	39.0
Thigh	37.0	38.5
Upper third	36.5	38.0
Middle third	36.0	36.5
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probably be localized in the region of the fistula. To test this concept, as well as to determine the degree of influence that the sympathetic nervous system has on a limb subjected to the physiologic changes attending an arteriovenous fistula of long standing we made studies on cutaneous temperatures as an indirect index of digital arterial blood flow.

## STUDIES OF CUTANEOUS TEMPERATURES OF ANIMALS HAVING CHRONIC ARTERIOVENOUS FISTULAS BEFORE AND AFTER LUMBAR SYMPATHECTOMY

Experimental studies (6, 11, 45, 46) have proved that under certain conditions the cutaneous temperature of the paw of an animal may be taken as an indication of the distal arterial blood flow. Consequently alterations of significant magnitude following sympathetic denervation should similarly serve as an acceptable indirect index of blood flow.

**Methods.** Two recording devices were employed in the measurement of cutaneous temperatures: (1) the Tyco's dermatograph-galvanometer apparatus with thermocouples adaptable to flat skin surfaces and (2) a mercury-bulb chemical thermometer used for measuring the temperature between the toes of the animal. Readings were taken in triplicate and careful control of the environmental conditions was exercised as advocated by Sheard (45) and Roth. A constant air temperature of 26 degrees C. was maintained and the humidity was kept at 40 per cent. Linear air movement was limited to 15 to 30 feet (4.6 to 9 meters) per minute. The skin surface was always dry clean and smooth shaven. The animals were kept comfortably recumbent for one hour to allow adjustment of the vasomotor system to a constant temperature. They were fasted 18 hours to exclude metabolic effects and the readings were taken at the same hour each morning to avoid diurnal variation.

These studies were performed on the same group of 19 animals used for the arteriovenous studies already described. During the 8 to 10 month period of observation the increase of circulating blood volume (average increase of 31 per cent) and heart size (average increase of 32.5 per cent) was noted. Together with the signs of arteriovenous fistula—vibratory con-

tinuous thrill, machinery murmur, distended pulsating venous channels, bradycardiac reflex, and so forth—there was adequate evidence that the fistula was patent during the entire time.

**Results.** The average normal temperature gradient as determined by cutaneous thermocouple readings on the medial aspect of the hind leg of a normal animal, from Poupart's ligament to the toes, was recorded. These values are those obtained on the control or right hind limb of the animals having left femoral arteriovenous fistulas (Table I a). From a temperature of 37.0 degrees C. obtained at the groin of the normal limb there was a gradual decrease distally to 31.5 degrees C. as measured in the interdigital web of the foot. On the leg with the fistula the temperatures ranged from 37.5 degrees C. at the groin to 30.0 to 30.5 degrees C. at the toes. In this limb, however, the thigh was warmer than proximally in the groin because of the presence of the aneurysm (38.5° C.). This effect by virtue of increased vascularity in the region of the aneurysm has been utilized clinically to localize a fistula. The great distention of superficial vessels made this entire thigh warmer than on the control side, but there was a rather sharp decrease of temperature of the ankle and foot to a value below that of the normal side.

the region of the aneurysm (Fig 3a) This was seen also in the series without sympathectomy and represents the degree of arterial response primarily as a result of time As the denervation had been bilateral, there was no significant gross difference in the general vascular bed of both limbs beyond that resulting from the aneurysm alone. The differences of cutaneous temperature of the limbs found are reported farther on in this paper They were accounted for on the basis of differences in the circulation supplying the limbs.

In the animals which had sympathectomy only on the side of the fistula there was a slight increase in diameter of the vessels on the denervated side over that of the control side. In all these animals, the greatest apparent increase was in the region just distal to the excised fistula (fig 3b) since here there were superimposed the outlines of those many small arteries which had dilated as a result of the aneurysm. However further evidence that the vasodilatation following sympathectomy affected the entire vascular segment will be presented in the section of this report dealing with cutaneous temperature.

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hesis or operation (Fig 5a'). This functional change in the response to stimuli which normally call forth a high degree of vasomotor activity had been similarly seen previously in the cool room experiment in which the normal limb did not constrict as well as the normal limb. This abnormal response may be explained by (1) altered distribution of blood volume in the limb, (2) the abnormal rôle of venous channels in carrying arterial blood and (3) disturbance of the functional and structural characteristics of the vessels as a result of long standing effects of the fistula.

A number of preliminary trials with ether anesthesia demonstrated this delayed response of the abnormal leg to be a constant finding. Despite the evidence of good collateral circulation we performed our operative removal of the lumbar sympathetic ganglia (L2 to and including L5) with the intervening chain by a transabdominal route. In 4 animals, the extirpation was bilateral in one stage so that there might be a control side with which to compare the physiologic response to sympathectomy. In the remaining 3 the procedure was carried out only on the side on which there was a fistula. This would more clearly reveal the results to be expected from clinical application of sympathectomy to a limb having an arteriovenous fistula.

Cutaneous temperatures of the toes and entire limb were obtained after the sympathectomy and these observations were recorded daily thereafter for more than two weeks. Then after a cool room test, the fistulas of 2 animals from both groups were excised after quadruple ligation.

Bilateral sympathectomy—Before sympathectomy the previously normal right leg showed a marked gradient of from 37.0 degrees to 31.5 degrees C. whereas after sympathectomy the skin surface of the entire limb was close to 37.0 degrees C. being lowest (35.5 C.) at the ankle (Table 1b). This demonstrated a maximal response of the cutaneous vessels to vasomotor denervation. The left limb which had had an arteriovenous fistula in the thigh for 7 months responded in much the same manner except for quantitative differences. As before sympathectomy, the thigh and leg were warmer than those of the

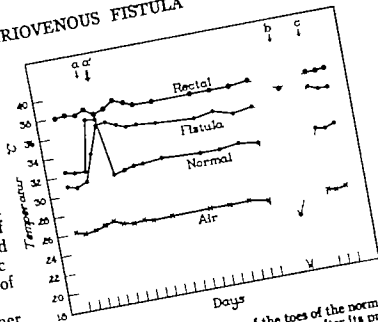


Fig 5. Cutaneous temperature of the toes of the normal foot and of the leg with the fistula, 7 months after its production, in addition to rectal and air temperatures a response to light ether anesthesia. a deep ether anesthesia and concurrent left lumbar ganglionectomy; b, cool room experiment; c quadruple ligation and excision of the fistula.

control limb but the foot and toes of the control were 0.5 to 1.5 degrees C. cooler than those of the control sympathetomized side. This relationship of toe temperatures therefore continued to be constant, even after sympathectomy indicating the rôle the fistula plays in preventing normal distal blood flow, regardless of environment or vasomotor activity.

Following the bilateral sympathectomy the same elevation of cutaneous temperatures of the toes was recorded as was obtained when the animals were under deep ether anesthesia preliminary to both unilateral and bilateral sympathectomy (Fig 5a'). During the succeeding 2 weeks however the temperature of both limbs decreased gradually about 1.0 to 1.5 degrees C. as measured between the toes.

When these animals were given the cool room test, that is exposure to an air temperature of 18 degrees C. for 30 minutes, neither limb showed significant evidence of vasoconstrictive ability. In 2 of the animals that had bilateral sympathectomy of 2 weeks duration the fistula was isolated and removed by quadruple ligation and excision. It was immediately noted that the removal of this communication was attended by a slight but significant rise in toe temperature to almost the equal of that of the control side. This is explained by a redistribution of arterial blood through the distal artery.



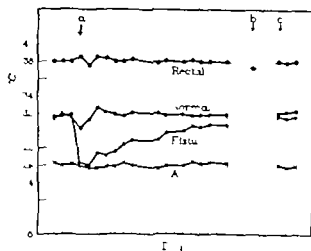


Fig. 4. Cutaneous temperature of the toes, in addition to rectal and air temperatures: the operative production of left arteriovenous fistula, *b*, cool room experiment; *c*, quadruple ligation and excision of the fistula.

Having demonstrated by arteriograms that these dilated channels did not extend to the foot we could depend with considerable confidence on temperature changes of the toes as being a reliable index of arterial flow.

In order to follow these changes closely, cutaneous temperatures of the toes were measured daily following the establishment of an arteriovenous communication in the left femoral vessels. Concurrent recordings were made of the rectal and air temperatures in order to note excessive variations of temperature in the body or in the environment. The control values noted prior to the vascular operation were rather constant (Fig. 4). Immediately after the production of an arteriovenous fistula there was a sharp drop of toe temperatures of the limb on which operation had been performed almost to room temperature (Fig. 4a). This was due to (1) vasospasm resulting from manipulation and (2) the distal ischemia due to the blood flow into the low pressure region at the fistula rather than to the tissues beyond. During the next day there was a sharp rise of the temperature of the leg with the fistula of about 2 degrees C., probably representing a decrease of vasospasm that had resulted from the operation. The normal leg and rectal temperatures rose slightly as evidence of a general reaction to the operation. This lasted but 1 to 3 days, and thereafter these temperatures followed the normal levels

(toe =  $31.5^{\circ}$  C. average rectal =  $38.0^{\circ}$  C. average). During subsequent days the toe temperature of the limb with the fistula increased but became relatively constant about 10 degree to 20 degrees C. below the control temperature of the right limb in 7 to 12 days.

In the subsequent period the response of the limbs to an abnormally cool environment was studied (Fig. 4b). On several occasions each animal was exposed to air temperature of 18 degrees C. for 30 minutes, and 15 minutes after removal of the animal to a room at about 26 degrees C. the temperature of the toes was recorded. It is significant that the normal side responded most efficiently to alterations of external environment. This greater vasoconstrictive ability of the normal limb made the leg with the fistula seem relatively warmer.

In some of the animals, quadruple ligation and excision of the fistula was performed after six months. A rise of toe temperature of the fistulous leg was noted on excision of the communication (Fig. 4c). This was probably due to redistribution of arterial blood with a more normal blood flow through the distal capillary beds.

*Effects of sympathectomy.* After a period of 7 months had been allowed for definite physiological changes to have taken place, so far as the general and local cardiovascular systems were concerned, 7 dogs were selected from the group and repeated preoperative temperature readings were taken (Fig. 5 up to a). Prior to a sympathectomy the animals were given ether anesthesia in an effort to simulate the effects of the operation since Herrick and associates and Baldes and associates had showed that the 2 procedures caused an identical increase in blood flow in the femoral artery of the dog. We soon discovered that under light ether anesthesia there was a lag in vasodilatation in the limb with the fistula, the rise in temperature being only about 2.5 degrees C. instead of the 5.5 degrees C. average of the normal side (Fig. 5a). This lessened response was shown to be a lag rather than organic inability to respond since under deep ether anesthesia (or lumbar sympathetic ganglionectomy) the temperature of the leg with the fistula continued to rise to a total average of 4.5 to 5.0 degrees C. higher than before anes-

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Bush (32) have reported cardiac failure in a period of only a few days or weeks after the development of a traumatic fistula. Fick found some of the vascular alterations irreversible and argued for early operation on patients who have arteriovenous fistula. Harbison has similarly urged early operation after employing sympathectomy to increase the collateral circulation so that frequently associated nerve injuries can be repaired easily. Elkin (9, 10) reported early operation to have been performed frequently on soldiers without even sympathetic block being necessary. However, the important effect that sympathectomy exercises on the full development of collateral systems has been emphasized by Mulvihill and Harvey. They concluded that at least the interruption of efferent vasomotor impulses by ganglionectomy imitates the establishment of the collateral circulation and to all appearances in the same manner as it occurs after a time of itself.

The first clinical application of this fundamental principle was reported by Gage (14) in 1933 in the treatment of a mycotic aneurysm of the iliac artery. By paravertebral sympathetic block the circulation in the limb was increased sufficiently to allow ligation of this large vessel with impunity. Subsequently in 1939 (15) he stated that he "had similar and satisfactory results with arterial and arteriovenous aneurysms.

Bird in 1935 was perhaps the first to report the preoperative use of sympathectomy preparatory to the repair of a major peripheral aneurysm. Plotkin in 1939 reported excellent results from lumbar sympathectomy of marked tomy performed in the presence of marked ischemia of the leg 1½ hours after excision of a popliteal arteriovenous fistula. In 1940 Waugh treated an arteriovenous fistula in which the collateral circulation was so poor that sympathectomy was done before excision of the fistula. The patient experienced such symptomatic improvement that he temporarily refused further treatment for the fistula. (Subsequently Waugh has had further recourse to sympathectomy as a preparation for obliterative procedures for arteriovenous fistulas.) In 1943 the "Military manual of traumatic surgery" (35) suggested that in cases of arterio-

venous fistula in addition to the usual methods of treatment, sympathectomy 'may be of value. Subsequently a War Department "Bulletin on care of battle casualties" (48) noted that while most arteriovenous fistulas do not require emergency treatment, a certain number must have early surgical treatment in the presence of hemorrhage, impending rupture paralysis from the pressure on the nerves near the aneurysm or threatened gangrene. It suggests that preoperative and postoperative injections of 1 per cent solution of procaine hydrochloride to block the sympathetic ganglia or sympathectomy may be used in vascular cases to improve circulation by removing vaso-spasm. Recently there have been promising reports by Linton and White, Pugh, Harbison, Kirtley, Mason and Giddings (31), Shumacker and Carter and Freeman in which there was definite evidence of stimulation of collateral circulation in chronic arteriovenous and arterial aneurysms by paravertebral block or sympathectomy. Early operation has been possible and when there was an attendant nerve injury repair of the nerve has been facilitated. Naide has had encouraging results from sympathetic block to supplement anti-toxin and penicillin in gas gangrene infections. This study has shown that while such a series

of sequel to arteriovenous fistula as ischemic gangrene is relatively uncommon there does exist frequently a preoperative and postoperative chronic vascular insufficiency which may be relieved by interruption of the sympathetic vasomotor control. The influence exerted by the earlier investigators in so far as depending on the time factor for the development of collateral circulation is very strong. Elkin (9) in his treatment of 106 patients who had traumatic aneurysms observed in a military hospital has not employed procedures that might be used to stimulate collateral circulation other than intermittent compression before employing obliterative operations. Many competent physicians have gone so far as to declare that attempts to improve circulation in cases of chronic arteriovenous fistula were actually contraindicated.

The results of clinical application of interruption of the sympathetic nerves performed to develop collateral circulation before opera-

olar and capillary beds as a result of removing the arteriovenous communication

**Unilateral sympathectomy**—As in the preceding experiment concurrent readings were made of both hind limbs rectal and air temperatures (Fig 5). These results represent the type of response one may expect in the clinical application of lumbar sympathectomy to patients having arteriovenous fistula of the leg.

The response to ether anesthesia in this series of animals was again identical with that previously described for the animals in other series. Under light anesthesia a lag in the temperature rise was noted in the limb with the fistula compared to the immediate complete response of the control normal limb (Fig 5a). With deep ether anesthesia the temperature continued to rise to a level about 1.0 degree C below that of the normal side (Fig 5a'). At this point left lumbar ganglionectomy was performed.

After recovery from ether anesthesia, the temperature of the control limb fell to the preoperative level or slightly lower indicating in some instances a contralateral vasoconstriction. This latter phenomenon was only transient however. On the sympathectomized side the elevated cutaneous temperature persisted at a level of about 37 degrees C. During the subsequent 2 weeks this significant rise of toe temperature was maintained with only a slight decline to about 36.0 degrees C or an elevation of 3.0 to 4.5 degrees C over that of the normal control side (Fig 5a to b). This fact demonstrated conclusively that the vessels distal to the fistula were indeed capable of further vasodilatation even after a period of 7 months in which collateral circulation had developed.

As in the other groups, these animals were given the cool room test there was only a slight fall of about 1.0 degree C in the temperature of the sympathectomized limb as compared with a decrease of temperature of more than 8 degrees C in the normal limb (Fig 5b). This is clear evidence that an anatomic interruption of the vasomotor nerves had been accomplished by the sympathetic ganglionectomy.

Two animals were selected from this group. Two weeks after the unilateral sympathec-

tomy the fistula was excised by quadruple ligation and excision. Once again a slight but significant rise of toe temperature was observed indicating increased distal arterial flow after obliteration of the fistula (Fig 5c).

**Comment** It is evident that our experiments have indicated that the blood flow in a limb may be significantly increased in the presence of a chronic arteriovenous fistula of a major peripheral artery following sympathetic denervation. The adequate treatment of arteriovenous fistula depends primarily on the condition of the collateral blood supply when an obliterative procedure is the method of choice. Naturally the secondary factors of general condition of the patient, his cardiac status and presence of infection or nerve involvement are important but in the presence of insufficient blood supply little choice remains to the surgeon beyond temporary vein ligation amputation or in certain cases, restorative endoaneurysmorrhaphy. In any operative procedure in which the arteries are involved one runs the ever present danger of disastrous vasospasm as a result of the surgical manipulation. The present-day safeguards against thrombosis, such as precise aseptic technique improved antibiotic agents and the anticoagulant drugs, heparin and dicoumarol, have made direct repair or ligation of major peripheral arteries a less formidable procedure than in the past century or even during World War I.

There is considerable evidence both direct and indirect that the majority of channels composing a collateral system are in existence, even though relatively inactive in the normally functioning part. In the dog many investigators have demonstrated by arteriography the ready appearance of supplementary arterial channels when obstruction had occurred in various regions. Vvedenski in the hind limb Kolesnikow in the fore limb Andreyev in the head.

The demonstration of the great differences in the arterial and arteriovenous bed in the limbs of our animals that had fistulas raises the question whether a surgeon is justified in waiting several months for collateral circulation to develop before closure of a fistula in a patient. Mason (30) and Mason Graham and

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Bush (32) have reported cardiac failure in a period of only a few days or weeks after the development of a traumatic fistula. Fick found some of the vascular alterations irreversible and argued for early operation on patients who have arteriovenous fistula. Harbison has similarly urged early operation after employing sympathectomy to increase the collateral circulation so that frequently associated nerve injuries can be repaired easily. Elkin (9, 10) reported early operation to have been performed frequently on soldiers without even sympathetic block being necessary. However, the important effect that sympathectomy exercises on the full development of collateral systems has been emphasized by Mulvihill and Harvey. They concluded that 'at least the interruption of efferent vasomotor impulses by ganglionectomy initiates the establishment of collateral circulation and to all appearances in the same manner as it occurs after amputation of itself'.

The first clinical application of this fundamental principle was reported by Gage (14) in 1933 in the treatment of a mycotic aneurysm of the iliac artery. By paravertebral sympathetic block the circulation in the limb was increased sufficiently to allow ligation of this large vessel with impunity. Subsequently in 1939 (15) he stated that he "had similar and satisfactory results with arterial and arteriovenous aneurysms."

Bird in 1935 was perhaps the first to report the preoperative use of sympathectomy preparatory to the repair of a major peripheral aneurysm. Plotkin in 1939 reported excellent results from lumbar sympathectomy of marked tomy performed in the presence of marked ischemia of the leg 1½ hours after excision of a popliteal arteriovenous fistula. In 1940 Waugh treated an arteriovenous fistula in which the collateral circulation was so poor that sympathectomy was done before excision of the fistula. The patient experienced such symptomatic improvement that he temporarily refused further treatment for the fistula. (Subsequently Waugh has had further recourse to sympathectomy as a preparation for obliterative procedures for arteriovenous fistulas.) In 1943 the 'Military manual of traumatic surgery' (16) suggested that in cases of arterio-

venous fistula, in addition to the usual methods of treatment sympathectomy 'may be of value.' Subsequently a War Department "Bulletin on care of battle casualties" (48) noted that while most arteriovenous fistulas do not require emergency treatment, a certain number must have early surgical treatment in the presence of hemorrhage impending rupture paralysis from the pressure on the nerves near the aneurysm, or threatened gangrene. It suggests that preoperative and postoperative injections of 1 per cent solution of procaine hydrochloride to block the sympathetic ganglia or sympathectomy may be used in vascular cases to improve circulation by removing vasospasm. Recently there have been promising reports by Linton and White Pugh, Harbison Kirtley Mason and Giddings (31) Shumacker and Carter and Freeman in which there was definite evidence of stimulation of collateral circulation in chronic arteriovenous and arterial aneurysms by paravertebral block or sympathectomy. Early operation has been possible and when there was an attendant nerve injury repair of the nerve has been facilitated. Naude has had encouraging results from sympathetic block to supplement anti-toxin and penicillin in gas gangrene infections. This study has shown that while such a serious sequel to arteriovenous fistula as ischemic gangrene is relatively uncommon there does exist frequently a preoperative and postoperative chronic vascular insufficiency which may be relieved by interruption of the sympathetic vasomotor control. The influence exerted by the earlier investigators in so far as depending on the time factor for the development of collateral circulation is very strong. Elkin (9) in his treatment of 106 patients who had traumatic aneurysms observed in a military hospital has not employed procedures that might be used to stimulate collateral circulation other than intermittent compression before employing obliterative operations. Many competent physicians have gone so far as to declare that attempts to improve circulation in cases of chronic arteriovenous fistula were actually contraindicated.

The results of clinical application of interruption of the sympathetic nerves performed to develop collateral circulation before opera-

# A NEW OPERATIVE TREATMENT FOR ELEPHANTIASIS

EDGAR J POTH M.D. Ph.D., F.A.C.S., SAM R. BARNES, M.D., and  
GRIFF T ROSS M.D. Galveston, Texas

**W**E shall not consider the various etiological factors of elephantiasis (Matas 1913) but shall concern ourselves with the late stage of persistent irreversible edema with fibrosis of the subcutaneous tissues and derma in those instances or recurrent crysipeloid infections due to lymphatic obstruction.

Homans (1928) Homans and Zollinger (1929) Homans Drinker and Field (1934) Reichert (1926 1927 1930) and many others have treated this subject experimentally and clinically. It has been concluded that the most satisfactory treatment of this malady is the complete removal of the lymphatic bearing tissues especially of the legs and occasionally of the thighs. Of the various procedures used to accomplish the removal of these tissues the Kondoleon (1912) operation of excising segments of skin and the underlying fibrous connective tissues extending down to the

muscles or by the undercutting of thin skin flaps and excising the lymphatic bearing subcutaneous tissues (Sistrunk 1927) have been used most extensively and are considered as giving the best results. These procedures are multiple time-consuming operations requiring long hospitalization. The condition frequently recurs or is not relieved. In a true elephantiasis with progressive fibromatosis as defined by Matas, the lymphatics of the derma are involved in addition to those of the subcutaneous tissue.

This paper describes a single operation for the removal of the lymphoid bearing tissues. The procedure is simply the excision of all tissues down to the sheaths of the muscles of the thigh and leg excepting a narrow strip covering the tibia anteriorly and then grafting the denuded surface with thick split grafts.

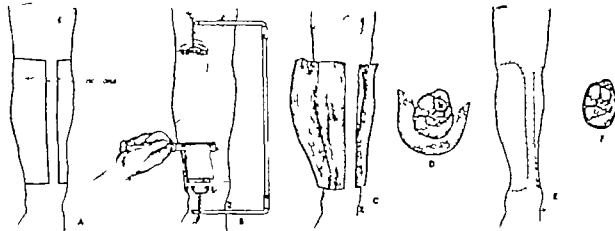
Alternate procedures are illustrated in Figures 1 and 2.

## CASE REPORT

C. M., No. 375574, white male aged 34 years was first observed to have an enlarged left leg at the age of 2 months which was subsequently diagnosed as

From the Department of Surgery, University of Texas, Medical Branch, Galveston, Texas.

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**Fig.** One stage operation for elephantiasis. A, The incisions are outlined so as to preserve full thickness of tissue over the tibia. B, If the condition of the skin is satisfactory, thick split grafts are cut before the tissues are dissected from the operative field. Grafts are cut from the entire circumference except for the narrow strip over the

tibia. C and D show the remaining derma and subcutaneous tissues being excised down to muscle with preservation of a strip of tissues over the tibia. E and F illustrate the situation after grafting with split skin grafts. Note: If indicated, the subcutaneous tissue over the tibia could be excised after healing has occurred.

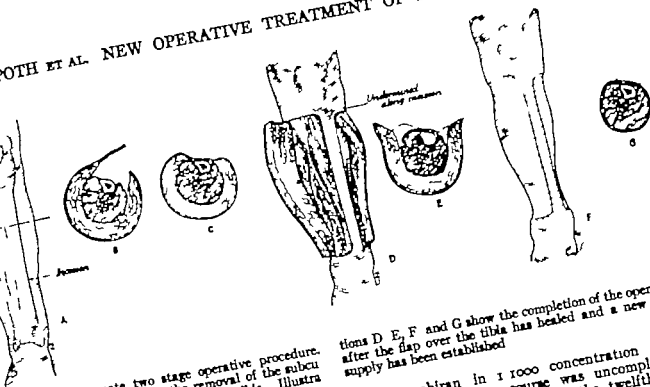


Fig. 2. An alternate two stage operative procedure. Illustrations A, B and C show the removal of the subcutaneous tissue from the area covering the tibia. Illustrations D, E, F and G show the completion of the operation after the flap over the tibia has healed and a new blood supply has been established.

Milroy's disease. The enlargement and edema have increased progressively with recurrent attacks of erysipeloid infection, pain, and fever. A Kondoleon operation in 1935 gave temporary improvement. Daily baths followed by sponging with 1:4000 zephiran solution as a preoperative measure succeeded in clearing the left leg of numerous small furuncles. The skin of the leg was thickened but still retained some elasticity. It was decided to cut split grafts from this surface before excising the remaining skin and subcutaneous connective tissues down to the muscle sheath, and to use these grafts to cover the dissected area. A strip of skin and subcutaneous tissue was left to cover the tibia anteriorly (Figure 1). If the local skin is not suitable for transplantation other donor sites should be selected. It is questionable whether the local skin should ever be used because the lymphatic vessels of the derma are involved in elephantiasis.

The skin grafts were dressed with glycerine con-

taining zephiran in 1:1000 concentration (Poth 1945). Postoperative course was uncomplicated. Dressings were first changed on the twelfth postoperative day. The appearance 3 weeks and 3 months postoperatively is shown in Figures 5 and 6.

The patient has been relieved of his disability and is working as a laborer. The edema of the foot has become progressively less. A year has passed without recurrence of infection. While no supportive dressing has been worn by this patient, it is desirable to use an elastic bandage or stocking for a year to 18 months following operation.

#### DISCUSSION

Many patients with elephantiasis are incapacitated by the enlarged limb. The operation outlined here causes considerable disfigurement and should not be undertaken early.

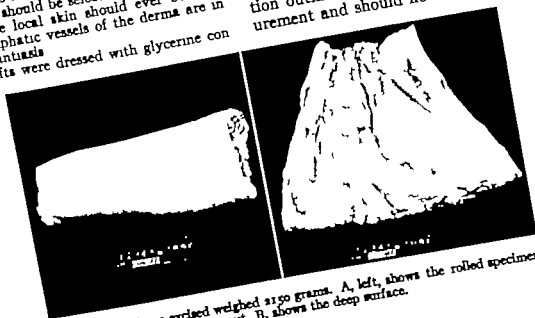


Fig. 3. The tissue excised weighed 2150 grams. A, left, shows the rolled specimen from which split grafts were cut. B, shows the deep surface.



# INDICATIONS FOR PORTACAVAL ANASTOMOSIS— ANALYSIS OF CASES

ARTHUR H. BLAKEMORE, M.D. New York, New York

THE first anastomosis to join the portal and caval system of veins was made in 1877 by Von Eck, a Russian physiologist. His operation upon dogs, anastomosing the portal vein to the vena cava, side-to-side, became widely known as the Eck fistula. Surgeons early recognized the rationale of establishing portacaval shunts for the relief of portal hypertension and over the years from 1903 to 1914 occasional case reports appeared in the literature (3, 4).

That severe portal hypertension may cause gastrointestinal hemorrhage has long been known, but the rôle of portal hypertension in conjunction with deranged blood proteins in association with ascites is more recently better understood. In an experience covering the completion of 23 portacaval anastomoses with follow up observations, some data having bearing upon the selection of cases for operation have been accumulated. Since the portacaval shunt affords a rational approach to the control or amelioration of hemorrhage due to portal hypertension I will first discuss indications for its use for this purpose.

Patients with congestive splenomegaly exhibiting Banti's syndrome who give a history of one or more episodes of gastrointestinal bleeding but whose liver function tests are essentially normal may be classified as cases of portal hypertension due to extrahepatic portal block. Such patients are candidates for a portacaval shunt. In the majority of these cases the portal block is due to cavernomatous transformation or atresia of the portal vein. Since it is not feasible to anastomose the portal vein to the vena cava in the above type of case the splenic vein to renal vein becomes the portacaval anastomosis of choice in this group. It is the surgeon's responsibility in dealing

with such cases to be prepared to perform a splenorenal anastomosis before proceeding with a splenectomy. Venous pressure readings, properly taken at operation, are an indispensable aid in localizing the site of obstruction in the portal radicals. It is now an established fact that splenectomy alone for congestive splenomegaly will cure only that relatively small group of cases of thrombosis of the splenic vein in which the site of obstruction is distal to the junction of the coronary vein. In such cases venous pressure readings taken from known branches of the superior mesenteric and coronary veins are found to be normal.

## THE RÔLE OF THE PORTACAVAL SHUNT IN PORTAL CIRRHOSIS OF THE LIVER

The very fact that hemorrhage or ascites or both can occur in cirrhosis cases purely on the basis of extremely depressed liver function places a great responsibility upon the surgeon in the selection of cases for the portacaval shunt operation. I will cite cases to illustrate this point.

The first case was that of the wife of a physician whose first complaint was uterine bleeding. A dilatation and curettage revealed no cause for the bleeding and finally during the performance of a hysterectomy cirrhosis of the liver was discovered. Subsequent liver function and chemistry studies revealed a badly decompensated liver. The prothrombin time was markedly elevated. The patient's general condition progressively deteriorated. Some 3 months later she experienced her first episode of gastrointestinal hemorrhage. Over a period of 5 months, the patient was continuously confined in the hospital suffering repeated hematemeses occurring at monthly intervals. Finally the patient was placed upon a high protein high carbohydrate diet with large doses of vitamin B complex. Gradually her appetite and strength improved. Some 4 months later following a 6 weeks vacation in Florida the patient was admitted to the Presbyterian Hospital for study. The liver was found to be rather hard and enlarged. There was no ascites present. Esophagograms revealed small esophageal varices. The blood proteins

From the Department of Surgery, The Presbyterian Hospital of the City of New York.  
Presented in the forum on Fundamental Surgical Problems before the Clinical Congress of the American College of Surgeons, Cleveland, Ohio, December 16-20, 1946.





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organized and clarified by classifying cases of cirrhosis in three groups as follows: Group I, cases in which ascites or a tendency to hemorrhage is based on the inability of the damaged liver to form albumin or prothrombin in adequate amounts. Portacaval anastomosis is not indicated in this group. Group II cases of cirrhosis in which the liver function is adequate to furnish the required amount of albumin and prothrombin but as a result of fibrotic contraction and periportal fibrosis a severe degree of portal hypertension has supervened. Wasting ascites and severe hemorrhage can be controlled in this group only by the portacaval shunt. Group III cases of cirrhosis having varying degrees of depressed liver function plus evidence of considerable elevation of the portal pressure. Such cases are candidates for the portacaval shunt operation but the question is when. It is our present policy to study the individual case with exceeding care when ever possible over a sufficient period of time to become thoroughly familiar with the behavior of the liver before bringing the case to operation. This is usually possible even in patients who have been subject to recurring hemorrhages. The idea is to improve liver function to its maximum employing a comprehensive liver regimen energetically applied for as long a period as necessary.

## DISCUSSION

The portacaval shunt operation is indicated and affords a chance of ultimate survival for cases of Banti's syndrome with extrahepatic portal block cases in which there is hypertension in the coronary or portal veins.

The portacaval shunt has an equally important rôle in the treatment of portal hypertension due to cirrhosis of the liver. But, its application must be decided on the basis of portal hypertension being the primary cause of hemorrhage or ascites in the individual case.

## ANALYSIS OF CASES

The portacaval shunt operation has been completed in 23 cases. There have been 4 postoperative deaths.

Hemorrhage from a sizable collateral vessel discovered at the conclusion of an anastomosis of the portal vein to vena cava accounted for

death in a case of cirrhosis of the liver. One cirrhotic patient died of cholemia 4 days following the establishment of a splenorenal shunt. Another cirrhotic patient died also of liver failure 6 days following the establishment of a portal vein to vena cava anastomosis. The fourth death resulted from mesenteric thrombosis occurring on the 14th day following a splenorenal anastomosis. The first death was the result of technical error. Death from liver failure in the 2 cirrhotic patients involves essentially errors in judgment in the selection of cases. Whereas mesenteric thrombosis is in the lap of the gods!

Patients have been explored in whom it was not feasible to accomplish a shunt operation. The majority of these patients had been subjected to a previous splenectomy. Of the 23 cases in which portacaval shunts were completed there were 15 patients who had anastomosis of the splenic vein to the renal vein following splenectomy and left nephrectomy. One of these patients had had a splenectomy at a previous operation. In one other post splenectomy bleeder it was possible to anastomose the stump of the splenic vein to the vena cava end to-side, by suture.

Anastomosis of the portal vein to the vena cava end to-side, was carried out seven times. A 12 millimeter vitallium tube was used four times (1) a 10 millimeter once and 8 millimeter vein lined tube once and suture anastomosis once.

Seventeen of the 19 patients surviving operation have a follow up exceeding 6 months. Two deaths have occurred one a child having portal cirrhosis, died some 2 years 4 months postoperatively of uremia due to polycystic disease of the kidney. The second case a man with bad portal cirrhosis, died 1 year following operation of cholemia. A necropsy examination was made in each case. In the child the splenorenal shunt had become occluded. This outcome was not unexpected because at operation in this, our first case there was considerable angulation of the splenic vein over the funnel edge of the vitallium tube. The splenorenal anastomosis in the second case was found to be patent.

Five additional patients with bad cirrhosis of the liver have been followed (2 cases 2



Fig 1. Case 536889. a, left, Infrared photograph. Note distention of abdomen with ascites, umbilical hernia and the presence of superficial collateral veins. b, Same patient 5 months after the establishment of a splenorenal shunt. The ascites has completely disappeared.

years each 3 cases  $1\frac{1}{2}$  years each) All for the most part, have done satisfactorily considering their preoperative status. All of the patients are active and 4 of the 5 are working. There was delay in disappearance of ascites following operation in 1 a minor bleeding episode in another.

I should like to discuss in more detail a sixth case, a patient with extrahepatic portal vein obstruction and biliary cirrhosis who has been followed now 2 years since the establishment of a splenorenal shunt.

**CASE 536889.** The question of performing a portacaval shunt procedure on this 46 year old man arose during an admission for hematemesis in November 1944. This was his 10th admission to the Presbyterian Hospital over a 7 year period.

His initial troubles began with an impacted gall stone causing cicatricial stenosis of the distal common duct and fibrotic pancreatitis. The latter caused partial obstruction of the duodenum and finally obstruction of the portal vein. As corrective measures, a gastroenterostomy and a cholecystic jejunostomy were performed. Some 5 years later because of recurring attacks of jaundice cholangitis, and a persistently high alkaline phosphatase, an

operation connecting the proximal end of the common duct to the pylorus using a vitallium tube was performed. In spite of this procedure over the next 3 years this patient's health continued to deteriorate. There was progressive loss of strength appetite, and weight. The episodes of cholangitis recurred in spite of long periods of therapy with sulfadiazine. The liver remained large with laboratory evidence of progressive cirrhosis. The spleen became more and more enlarged *pari passu* with the development of prominent superficial veins over the abdomen. Finally esophagograms revealed the presence of varices. Ascites supervened. Over an 8 month period prior to this admission the patient suffered five episodes of severe gastrointestinal hemorrhage.

On November 30, 1944, a splenorenal portacaval shunt employing a vein graft with two 5 millimeter vitallium tubes was carried out. Following the above procedure there was a reduction in size of the superficial abdominal veins. The ascites, which had been present for some 8 months before operation, gradually disappeared. Over the first 10 $\frac{1}{2}$  months following the establishment of the portacaval shunt, the patient gained 25 pounds. His appetite and digestion were excellent. He was working daily until October 12, 1945 when he caught cold. Following a severe coughing attack the patient had abdominal pain and 2 days later the patient passed 2 or 3 tarry stools. This episode cleared promptly however

# BLAKEMORE INDICATIONS FOR PORTACAVAL ANASTOMOSIS

with a rapid return of strength and appetite. Some 3 months later in January 1946 the patient began to have gas on the stomach with upper abdominal pain. The pain was relieved temporarily by eating or the ingestion of alkalis. One month later (February 1946) the patient again passed a few tarry stools. He was hospitalized for a short while during which he recovered his strength from intermittent abdominal pain. A month later (March 25, 1946) the patient was admitted for his third episode of tarry stools since the portacaval shunt operation. Because of the persistence of intermittent attacks of abdominal pain favorably affected by the ingestion of food or alkali the presence of a marginal ulcer was considered but not proved by x ray. Nevertheless this patient's stools did not become guaiac negative until after the administration of amphotel therapy during which time the attacks of abdominal pain entirely disappeared. The patient has continued free of digestive symptoms or pain now some 6 months during which there has been no recurrence of bleeding from the gastrointestinal tract.

See Figure 1: infrared photographs a before operation b 5 months after operation.

This patient has had three episodes of gastrointestinal bleeding since operation. Three possible causal factors may be discussed in explaining the recurrence of bleeding:

- 1 Occlusion of the anastomosis: a femoral vein graft mounting a 5 millimeter vitallium tube on either end was employed to bridge the splenic and renal veins in this case—a technique which combined what we now consider objectionable features, namely the employment of a vein graft and the use of vitallium tubes of a diameter undesirably small. On the other hand, there is an extremely good argument against occlusion of the anastomosis as being the cause of the recurrence of bleeding in this case.

- 2 Hemorrhage from a marginal ulcer at an old gastroenterostomy site. Against this as a source of bleeding was the failure to demonstrate a marginal ulcer in this case by x ray. It is of extreme interest, however, that the first bleeding episode to occur following the establishment of the portacaval shunt manifested itself in tarry stools 2 days after the onset of epigastric pain. The patient stated that at the time he had a coryza and a productive cough—the pain following a coughing episode. Three months later the epigastric pain recurred accompanied by the eructation of gas. The ingestion of food would relieve the pain

temporarily. These new symptoms persisted and during the next 3 months occurred the second and third bleeding episodes. The persistence of guaiac positive stools and abdominal pain was protracted until the institution of amphotel therapy following which the pain ceased and the stools rapidly became guaiac negative. The patient's digestion and appetite improved steadily and now 6 months later the patient has gained 18 pounds and his stools remain guaiac negative.

- 3 A third possible explanation for the bleeding in this case is a logical one, namely the rather small (5 mm) vitallium tubes employed may not handle a volume of blood adequate to lower pressure in the portal radicals sufficiently under conditions of sudden strain or possibly in the presence of mucosal ulceration. One look at the size of the collateral veins over this man's abdomen lends distinct credence to this explanation.

Though a splenorenal shunt be not adequate in size to afford total protection against the occurrence of bleeding that does not mean it will not do yeoman service in lessening the number and severity of attacks—a logical explanation of the clinical behavior in this case.

Our experimental evidence and clinical experience indicate that if a blood vessel anastomosis remains patent up to 60 days following operation it is extremely likely to remain open permanently. Here is a man who for 8 months prior to operation had ascites requiring paracentesis. During this period there were 5 episodes of severe gastrointestinal hemorrhage including hematemesis. For a month prior to operation the patient's condition was extremely precarious due to persistent gastrointestinal bleeding. A splenorenal shunt was established at this point. Following operation there was marked clinical improvement. The ascites disappeared and there was a gradual gain in weight of 22 pounds.

It is logical to conclude that the patency of the anastomosis accounted for the disappearance of ascites in this case. The presence of persistent ascites for 8 months prior to operation had been conceded by all to be on the basis of portal vein compression due to a fibrosing pancreatitis. Whereas the patient did have biliary cirrhosis there was never at





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His initial troubles began with an impacted gall stone causing concentric stenosis of the distal common duct and fibrotic pancreatitis. The latter caused partial obstruction of the duodenum and finally obstruction of the portal vein. As corrective measures, a gastroenterostomy and a cholecystojejunostomy were performed. Some 5 years later because of recurring attacks of jaundice, cholangitis, and a persistently high alkaline phosphatase an

operation connecting the proximal end of the common duct to the pylorus using a vitallium tube was performed. In spite of this procedure over the next 3 years this patient's health continued to deteriorate. There was progressive loss of strength, appetite, and weight. The episodes of cholangitis recurred in spite of long periods of therapy with sulfadiazine. The liver remained large with laboratory evidence of progressive cirrhosis. The spleen became more and more enlarged *pari passu* with the development of prominent superficial veins over the abdomen. Finally esophagograms revealed the presence of varices. Ascites supervened. Over an 8 month period prior to this admission the patient suffered five episodes of severe gastrointestinal hemorrhage.

On November 30 1944, a splenorenal portacaval shunt employing a vein graft with two 5 millimeter vitallium tubes was carried out. Following the above procedure there was a reduction in size of the superficial abdominal veins. The ascites, which had been present for some 8 months before operation, gradually disappeared. Over the first  $10\frac{1}{2}$  months following the establishment of the portacaval shunt, the patient gained 25 pounds. His appetite and digestion were excellent. He was working daily until October 12 1945 when he caught cold. Following a severe coughing attack, the patient had abdominal pain and 2 days later the patient passed 3 or 4 tarry stools. This episode cleared promptly however

## BLAKEMORE INDICATIONS FOR PORTACAVAL ANASTOMOSIS

with a rapid return of strength and appetite. Some 3 months later in January 1946 the patient began to have gas on the stomach with upper abdominal pain. The pain was relieved temporarily by eating or the ingestion of alkalis. One month later (February 1946) the patient again passed a few tarry stools. He was hospitalized for a short while during which he recovered his strength nicely but continued upon discharge to suffer daily from intermittent abdominal pain. A month later (March 25, 1946) the patient was admitted for his third episode of tarry stools since the portacaval shunt operation. Because of the persistence of intermittent attacks of abdominal pain favorably affected by the ingestion of food or alkali the presence of a marginal ulcer was considered but not proved by x ray. Nevertheless this patient's stools did not become guaiac negative until after the administration of amphojel therapy during which time the attacks of abdominal pain entirely disappeared. The patient has continued free of digestive symptoms or pain now some 6 months during which there has been no recurrence of bleeding from the gastrointestinal tract.

See Figure 1: infrared photographs, a before operation b 5 months after operation

This patient has had three episodes of gastrointestinal bleeding since operation. Three possible causal factors may be discussed in explaining the recurrence of bleeding:

- 1 Occlusion of the anastomosis—a femoral vein graft mounting a 5 millimeter vitallium tube on either end was employed to bridge the splenic and renal veins in this case—a technique which combined what we now consider objectionable features namely the employment of a vein graft and the use of vitallium tubes of a diameter undesirably small. On the other hand there is an extremely good argument against occlusion of the anastomosis as being the cause of the recurrence of bleeding in this case.

- 2 Hemorrhage from a marginal ulcer at an old gastroenterostomy site. Against this as a source of bleeding was the failure to demonstrate a marginal ulcer in this case by x ray. It is of extreme interest however that the first bleeding episode to occur following the establishment of the portacaval shunt manifested itself in tarry stools 2 days after the onset of epigastric pain. The patient stated that at the time he had a coryza and a productive cough—the pain following a coughing episode. Three months later the epigastric pain recurred accompanied by the eructation of gas. The ingestion of food would relieve the pain

temporarily. These new symptoms persisted and during the next 3 months occurred the second and third bleeding episodes. The persistence of guaiac positive stools and abdominal pain was protracted until the institution of amphojel therapy following which the pain ceased and the stools rapidly became guaiac negative. The patient's digestion and appetite improved steadily and now 6 months later the patient has gained 18 pounds and his stools remain guaiac negative.

- 3 A third possible explanation for the bleeding in this case is a logical one, namely the rather small (5 mm) vitallium tubes employed may not handle a volume of blood adequate to lower pressure in the portal radicals sufficiently under conditions of sudden strain or possibly in the presence of mucosal ulceration. One look at the size of the collateral veins over this man's abdomen lends distinct credence to this explanation.

Though a splenorenal shunt be not adequate in size to afford total protection against the occurrence of bleeding that does not mean it will not do yeoman service in lessening the number and severity of attacks—a logical explanation of the clinical behavior in this case.

Our experimental evidence and clinical experience indicate that if a blood vessel anastomosis remains patent up to 60 days following operation it is extremely likely to remain open permanently. Here is a man who for 8 months prior to operation had ascites requiring paracentesis. During this period there were 5 episodes of severe gastrointestinal hemorrhage including hematemesis. For a month prior to operation the patient's condition was extremely precarious due to persistent gastrointestinal bleeding. A splenorenal shunt was established at this point. Following operation there was marked clinical improvement. The ascites disappeared and there was a gradual gain in weight of 22 pounds.

It is logical to conclude that the patency of the anastomosis accounted for the disappearance of ascites in this case. The presence of persistent ascites for 8 months prior to operation had been conceded by all to be on the basis of portal vein compression due to a fibrosing pancreatitis. Whereas the patient did have biliary cirrhosis, there was never at

TABLE I.—PROTEINS

Name		Preoperative			Postoperative		
		Total proteins	Albumin	Globulins	Total proteins	Albumin	Globulins
1. Demora 47 M 757773	Esophageal varices Splenorenal shunt	6.6	9	3.7	7	3.6	3
2. Box 47 F 77736	Esophageal varices Eck fistula	7.8 8	4.3 3.9 4	3.5 4	8.6 8.6	3.4 4	5 4
3. Fahnd 5 F	Ascites Esophageal varices Splenorenal shunt	8	4.5	3.7	7.4 7 7.3	3.3 3.7 3.8	9 1 3 3.5
4. Schefingarten 48 M 157 90	Esophageal varices Eck fistula Vein graft	8.5	3.3	5	6.9 7 7.8 8.8 6	4 4 (2)	3 4 3 3 7
5. Coccaro 43 M 754188	Ascites Esophageal varices Splenorenal shunt	7.5	3.3	4	6 6.3 6.3	3 6	3.7 4.2 3.9
6. Mooney 55 M 150630	Esophageal varices Splenorenal shunt	5.7 7 6	3.3 3.3 3.3	5 3.3 0	6 7 5.8 6.5	3.7 4 3 3.6	7 3 7 8
7. Leung 40 M 75307	Ascites Eck fistula	5.3	3	3	5.9 5 5.7	3.6 6 3	1 6
8. Iscoletti 58 M 764905	Ascites Eck fistula	5	0	3	4.8 4.9 7 5 5 6	5 3 9 3	4 3 3 3 3 4

NOTE. All cases of carcinoma of the liver

any time evidence of decompensation of the liver. Furthermore up until the time of disappearance of the ascites following the establishment of the portacaval shunt, the patient was not on a liver dietary regimen. In view of the above fact, if the bleeding episode which occurred 10½ months after operation in this man had been due to a sudden closure of the splenorenal shunt one would have expected a prompt return of the ascites. In fact, in a very recent case in which thrombotic occlusion did take place the prompt occurrence of ascites antedated the appearance of esophageal bleeding by 2 weeks.

It seems reasonable that this man's splenorenal shunt may be open but not of a size adequate to shunt enough blood to afford complete protection against hemorrhage. After

all, he has had only three episodes of gastrointestinal hemorrhage in a 24 months post operative period compared to 5 attacks over an 8 months period before operation. He is free of ascites, and working.

We do not have, as yet, enough follow-up data on portal pressures before and after opening portacaval shunts to predicate what pressure level will afford absolute protection against hemorrhage. However we do have data upon portal pressures to indicate that the splenic vein may not always be of adequate size to afford a shunt sufficiently large to protect against episodes of hemorrhage. As a possible corollary to the importance of the size of the shunt our follow-up has not so far been complicated by hemorrhage in those cases in which direct anastomoses of the portal



terminal illness from liver failure. Whereas it seems likely that a low blood prothrombin level may have contributed to the initiation of hemorrhage, it must be remembered that this patient still had a portal pressure of 240 millimeters of water following opening of the shunt. Before operation the portal pressure was 400 millimeters of water—the highest pressure we have yet recorded on a case of cirrhosis. Though this patient's ascites cleared following operation his jaundice persisted. His terminal illness was ushered in by a high fever from what appeared to be an upper respiratory infection. It is only fair to state at this point however that following the establishment of a splenorenal shunt, this man's appetite strength and weight improved. He was able to return for part time work to his job as a barber.

The above case proves that a splenorenal shunt, though patent, may not be of a size adequate to shunt an amount of blood sufficient under all conditions to afford absolute protection against future hemorrhage. Three additional cases over a 2 year follow up period have shown such marked overall clinical improvement following the portacaval shunt operation as to justify including them in the above classification.

One of the cases has already been discussed in detail. One case a girl of 15 years having Banti's syndrome with extrahepatic portal block was found to have a portal pressure of 310 millimeters of water. Following the opening of a splenorenal anastomosis the portal pressure receded to 190 millimeters of water. This patient gained strength and weight following operation but over a 2½ year (30 month) follow-up period she has had three episodes of gastrointestinal bleeding. Two of these hemorrhages were comparatively trivial to the attacks which came regularly at 6 month intervals before operation.

A third case a cirrhotic who gave a long past history of hematemesis, was operated upon following a month's seizure of hemorrhage during which the stools failed to become guaiac negative. Following the establishment of a portacaval shunt, this man's general condition improved markedly. His jaundice gradually improved as well as his liver

function tests. A few months after operation, the patient returned to his job and has been working ever since. Over a 2 year follow-up period this man has had one comparatively minor bleeding episode consisting of 2 or 3 tarry stools.

Finally there are 3 cases in which the evidence points to closure of the portacaval anastomoses. All 3 cases have Banti's syndrome with a past history of frequent episodes of gastrointestinal bleeding including hematemesis. In 1 case that of a 15 year old girl, who 4 years previously had had a splenectomy an anastomosis was effected by suture of the stump of the splenic vein to one branch of the left renal vein. To the other branch of the renal vein (following nephrectomy) the proximal stump of the inferior mesenteric vein was anastomosed employing a 5 millimeter vitallium tube. Thrombotic occlusion of the anastomoses was heralded by the sudden appearance of ascites on the seventh postoperative day. Some 2 weeks later the patient had an attack of hematemesis. The bifurcated renal branches were rather small in this case and in retrospect it would possibly have been better judgment to have been satisfied with one anastomosis.

The second case was that of an 8 year old boy who one year previously had had a splenectomy. The boy had Banti's syndrome complicated by bronchiectasis. During the year following splenectomy the boy suffered 5 episodes of severe gastrointestinal hemorrhage including hematemesis. The proximal stump of the splenic vein was anastomosed to the vena cava by suture end-to-side. During a year following this procedure, as presumptive evidence of closure of the anastomosis, the hemorrhages have recurred with equal frequency and severity.

Finally in a child 3 years of age an end-to-end suture of the splenic vein to the renal vein has failed to lessen the tendency to hemorrhage over a year's follow up period.

#### SUMMARY

In presenting the rationale of the portacaval shunt for the relief of portal hypertension, special stress is placed upon the selection of cases.

# BRANTIGAN ANOMALIES OF PULMONARY VEINS

An analysis of 23 cases having portacaval anastomosis was presented

The procedure is presented as the one hope of relief for those cases with Banti's syndrome who have essentially normal livers but present the problem of control of gastrointestinal hemorrhage

The importance of exercising extreme care and judgment in the selection of cases of cirrhosis for operation and the reasons thereof are discussed

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## ANOMALIES OF THE PULMONARY VEINS

### Their Surgical Significance

O C BRANTIGAN M.D. F.A.C.S., Baltimore, Maryland

THE reports of anomalies of the pulmonary veins are appearing more frequently in the medical literature. In the past all descriptions and case reports have come from autopsy material or from studies made in the anatomic laboratory. This article will describe and discuss anomalies of the pulmonary veins found at the time surgical operations were being performed upon the lungs.

Brody made a review of the literature and in 1942 presented an excellent discussion of the subject. The final study included 106 patients. Since 1942 seven different authors have reported 14 additional cases (3, 4, 7, 8, 10, 11, 12). Brody classified the anomalous venous drainage from the lungs as (1) total drainage into the right atrium or its tributaries 36 per cent and (2) incomplete drainage into the right atrium or its tributaries 64 per cent. When the venous drainage from the lungs into the right atrium or its tributaries is incomplete the most common site for drainage in order of frequency is the superior vena cava, right atrium and the left innominate vein. The right pulmonary vein is anomalous in its drainage twice as frequently as the left.

Anomalous pulmonary veins have been described as draining into the following superior vena cava, right atrium, left innominate vein, coronary sinus, inferior vena cava, azygos vein, left subclavian vein, portal vein and persistent left superior vena cava.

It has been suggested that if less than 50 per cent of the pulmonary blood is abnormally shunted into the major venous system or into the right side of the heart, the patient is unlikely to develop cardiac decompensation. Such an assumption is based upon a normal heart. Hughes and Rumore were the first to give actual figures that might indicate the quantity of pulmonary blood that flows abnormally into the major venous system from an anomalous pulmonary vein. Both of the patients they described died of cardiac failure and both had rheumatic heart disease. By comparison of the cross-sectional area of anomalous veins with the cross-sectional area of the normal pulmonary veins they calculated that in one patient 26 per cent and in another 20 per cent of the pulmonary blood was shunted into the major venous system. It is difficult to calculate the effects of this additional effort upon the already injured heart. Conant and Kurland described a patient who tolerated extensive tuberculosis in the left lung but died rapidly when the right lung became infected. At autopsy it was found that



terminal illness from liver failure. Whereas it seems likely that a low blood prothrombin level may have contributed to the initiation of hemorrhage it must be remembered that this patient still had a portal pressure of 240 millimeters of water following opening of the shunt. Before operation the portal pressure was 400 millimeters of water—the highest pressure we have yet recorded on a case of cirrhosis. Though this patient's ascites cleared following operation his jaundice persisted. His terminal illness was ushered in by a high fever from what appeared to be an upper respiratory infection. It is only fair to state at this point, however, that following the establishment of a splenorenal shunt, this man's appetite strength, and weight improved. He was able to return for part time work to his job as a barber.

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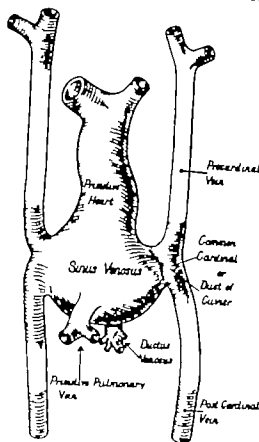


Fig. A diagrammatic conception of the primitive venous system viewed from the dorsal aspect. The primitive pulmonary vein enters the dorsal side of the sinus venosus. This conception was accepted by the early embryologists.

the blood from the left lung drained anomalously and completely into the left innominate vein. Disease of the nonfunctioning lung caused little embarrassment to the patient, but disease of the functioning lung was rapidly fatal. Thus, the physiologic effect of pulmonary blood shunted into the major venous system will be influenced by disease in the functioning lung or by disease of the heart.

The seemingly wide and unrelated variations that occur in pulmonary venous anomalies have been studied from the embryologic point of view in an endeavor to simplify and correlate the anomalies encountered. Brown reviewed the research that had been done on the development of the pulmonary veins and wrote it is evident that (1) The anlage of the vein and its connections with sinus venosus has not been described in detail and (2) the method by which the vein changes its orifice in the center of the sinus venosus for one in

that position of the sinus which lies to the left of the left sinus valve has not been considered. In addition the general relation which the pulmonary venous system bears to the systemic has been entirely neglected in the study of the embryology of the vein." In the 4.5 millimeter cat embryo he reported "At this stage the pulmonary vein exists as a single vessel having two main vascular connections, (1) ventrally a single rounded orifice in the sinus venosus (Fig. 1) and (2) dorsally a connection with that portion of the splanchnic plexus which is pushed forward by the growing pulmonary anlage which it joins at the ventral pole of the lung bud. Thus, the pulmonary venous plexus through the splanchnic venous plexus is connected with the primitive major venous system by the way of both the precardinal and postcardinal veins. In the 6.5 to 7 millimeter embryo he further related "The sinus venosus with the exception of the openings of the cornua has been incorporated into the auricle. The right valve of the sinus is very prominent and is continued into the septum spurium which has shifted to the left and fused with the septum superius. The left valve of the sinus has likewise shifted to the left and its cephalic extremity on the dorsal wall of the auricle has fused with the dorsal caudal portion of the septum superius. As a result of the latter shift the orifice of the pulmonary vein has preceded the left valve of the sinus, passed under the septum superius and now empties into the left auricle having both septum superius and left valve of the sinus or in other words, the interauricular septum on the right. This view is no longer considered to be true in human development. It is thought that the venous plexus covering the primitive lung bud is probably a development from the splanchnic venous plexus (Fig. 2). The pulmonary venous plexus is gathered together into a common pulmonary vein that joins directly and definitively with the left auricle (6:16). Patten in describing human embryology said "Phylogenetically the lungs are relatively new structures. It is not surprising, therefore, that we find the pulmonary veins arising independently and not by the conversion of old vascular channels. They originate as vessels which drain the various branches of

## BRANTIGAN ANOMALIES OF PULMONARY VEINS

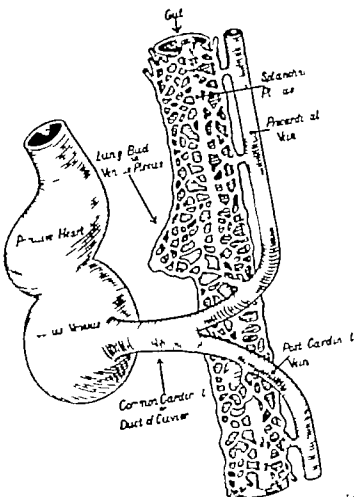


Fig. 2 A lateral view diagrammatically representing the primitive venous system and the lung bud and its venous plexus. The primitive pulmonary plexus is an outgrowth from the primitive splanchnic venous plexus. The primitive pulmonary vein arises from the splanchnic venous plexus and communicates with the precardinal and postcardinal veins. The pulmonary vein will join the common pulmonary venous plexus. This concept is directly and definitively with the left atrium. This conception of development for the most part is accepted by contemporary embryologists.

the lung bud and converge into a common trunk entering the left atrium dorsally. In the growth of the heart this trunk vessel is gradually absorbed into the atrial wall until usually 4 of its original branches come to open into the left atrium as the pulmonary veins of the adult. Less than the usual amount of resorption of the primitive common pulmonary vein not infrequently results in the pulmonary veins from the right and the left lungs entering the left atrium as single instead of the usual paired vessels (Fig. 4). In continuation of the discussion Patten made the statement "Occasionally startling anomalous connections of the pulmonary veins are seen such as

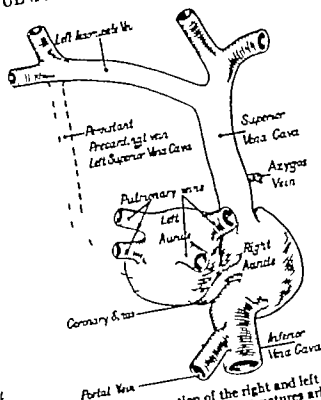


Fig. 3 With the exception of the right and left atria, the diagram presents the normal adult structures arising from the primitive venous system. It is viewed from the posterior aspect. If there is a left superior vena cava it is the result of a persistence of the normal remains of the old precardinal vein on the left side. If the pulmonary blood is drained abnormally into the right atrium or its tributaries it will drain into one of the structures indicated on this diagram.

the entrance of one of them into the superior vena cava the left innominate or the azygos. Such conditions are explicable only on the basis of exceedingly early embryonic stages in which the developing foregut trachea and lung buds are supplied by a common plexus of small channels which thread in all directions through the loose mesenchyme and communicate with the primitive cardinal veins freely in many places (Fig. 2). With the enlargement of certain channels in the primordial vascular bed to form pulmonary veins leading to the left atrium the primitive connections with the cardinal veins ordinarily disappear. The unusually strong development of some of these early channels and its retention by the adult derivative of the particular part of the cardinal system involved is behind the occurrence of these abnormal pulmonary connections."

The primitive venous system consisting of the cardinal veins and sinus venosus give rise

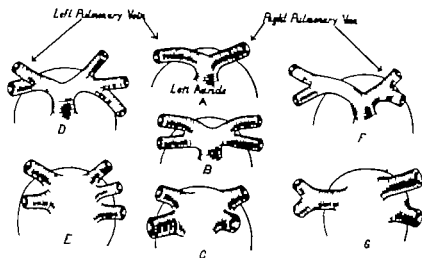


Fig. 4. The method of development of an abnormal number of pulmonary veins entering the left atrium is indicated by the diagrams A to G. The dorsal aspect is presented. The primitive pulmonary vein enters the left atrium as a single venous trunk. The primitive single venous trunk is divided into right and left pulmonary veins, A. The right and left pulmonary veins are divided into two veins, B. There is resorption of the venous trunks into the wall of the left atrium until in the normal adult atrium four pulmonary veins open separately into the posterior aspect of the atrium, C. If the right pulmonary vein divides into three branches, D, one for each lobe, close to the atrium they will be resorbed into the atrial wall, thus giving rise to three separate openings on the right side E. If the left pulmonary vein divides into two branches at a greater than normal distance from the atrial wall F they will not be taken up into the atrium and thus only one orifice will open into the atrium on the left, G.

in the adult to the right and left innominate veins, the coronary sinus, the azygos vein, the superior vena cava, the portion of the inferior vena cava adjacent to the atrium, a part of the right atrium and a portion of the portal vein adjacent to the liver. Abnormalities in the persistence of the cardinal veins may give rise in the adult to abnormal azygos veins and to a left superior vena cava (13, 14). When there is anomalous drainage of blood from the lungs, according to all past reports, it has been drained into one of the structures above named. Abnormal sites of drainage of pulmonary blood at first glance seem unpredictable but actually they are rather normal from the embryologic point of view. This blood will always drain into some structure originating from the primitive venous system (Fig. 3).

If the early pulmonary veins once drained into the sinus venosus an abnormal shift of its final drainage point could easily account for an abnormal pulmonary drainage into any of the structures originating from the primitive venous system and especially the emptying of pulmonary veins into the right atrium.

Should the pulmonary veins originate from the splanchnic venous plexus (Fig. 2) and then drain first and definitively into the left atrium, certain early connections of the splanchnic venous plexus with the cardinal venous system may persist and thus account for the anomalous drainage of pulmonary blood into any part of the major venous system originating from the primitive venous system. If there is failure of junction of the early pulmonary vein with the left atrium then all blood from the lungs must find an anomalous pathway for drainage. Thus, all anomalies that have been described can be accounted for whether one accepts the old or the new embryologic theory of pulmonary vein development (Fig. 1, 2, 3 and 4).

Embryologists seem to agree upon the essential method of development of multiple openings of the pulmonary vein into the left atrium. The method is described adequately in the quotation from Patten. The various anomalous openings and their method of development have been indicated by the diagrams in Figure 4.

## BRANTIGAN ANOMALIES OF PULMONARY VEINS

In the last 3 years pulmonary venous anomalies have been recognized by the author at the operating table. While undergoing pneumonectomy 3 patients were found to have only one pulmonary vein on the left side. Thus, to remove the left lung only one pulmonary vein was ligated. In each patient the single vein was ligated as it entered the pericardium. During pneumonectomy 2 other patients presented 3 pulmonary veins on the right side, or an individual vein for each lobe of the lung on the right side. Upon removal of the lung in these 2 patients 3 veins were ligated as they entered the pericardium. In 1 patient where the right lung was removed for tuberculosis the pulmonary vein from the upper lobe of the right lung drained into the inferior vena cava. The pulmonary vein from the middle and lower lobes of the right lung drained into the left auricle. While doing a closed intrapleural pneumonolysis on the left side a pulmonary vein from the upper lobe of the left lung was found draining into the left innominate vein. Since this lung was not removed and since it was viewed through a thoracoscope the interpretation may be erroneous.

When the various anomalies of the pulmonary veins are understood it is reasonable to expect that they will be recognized with greater frequency at the operating table. It is evident that these anomalies are of considerable surgical importance. This importance is mitigated by rarity and enhanced by common occurrence.

Pulmonary vein anomalies can be classified into two groups (1) an abnormal number of pulmonary veins emptying into the left atrium (2) abnormal drainage of the pulmonary veins (a) partial drainage into the right atrium or its tributaries (b) total drainage into the right atrium or its tributaries.

In performing a lobectomy by means of the individual ligation technique the presence of more than a single pulmonary vein must be demonstrated in order to avoid devitalizing the whole lung. When 3 veins are present on the right side the ligation of the vein draining the lobe is facilitated. The variable number of veins that may be found draining the lung is well recognized and described in the standard

textbooks of anatomy (95). If the pulmonary veins were inspected inside the pericardium it seems reasonable to expect that a single pulmonary vein on either side would be of more common occurrence.

It has been recognized that the drainage of pulmonary blood into the major venous system or into the right atrium is a burden upon the heart. The thoracic surgeon endeavors to conserve healthy lung tissue when resection of the lung is necessary. It is important to recognize pulmonary venous anomalies when the thorax is open, since the removal of such a lobe of the lung would be beneficial to the patient by eliminating the burden placed upon the heart. Lobectomy of the upper lobe is commoner than lobectomy of the lower lobe of the lung. If the pulmonary vein of an upper lobe drains into the major venous system and the normally draining lower lobe is removed it will increase the relative percentage of pulmonary blood drained into the major venous system. Accordingly it will increase the cardiac burden and should be removed. The most common anomalous pulmonary venous drainage is the drainage of the pulmonary vein from the upper lobe of the right lung into the superior vena cava.

For the thoracic surgeon it is frightening to contemplate the possibility of removing one lung only to find that the other lung drained its blood into the major venous system as in the patient described by Conant and Kurland. Fortunately the drainage of one lung into the major venous system is uncommon. Judged from case reports it occurs about as often as drainage of the total pulmonary blood into the right atrium or its tributaries. Actually, 31 such cases have been reported.

In the past a diagnosis of total drainage of pulmonary venous blood into the right atrium or its tributaries has not been made before death. In such patients death usually coincides with the closure of the foramen ovale. It is not unreasonable to believe that some day the condition will be diagnosed before death. If that were possible it would be interesting to speculate upon an operative attack. The interatrial septum might be removed or a major pulmonary vein could be anastomosed to the left atrium.

## CONCLUSIONS

1 The anomalous drainage of pulmonary blood is being recognized with increasing frequency

2 When there is anomalous drainage of blood from the lung it drains into some structure arising from the primitive venous system.

3 An anomalous number of pulmonary veins draining into the left atrium is not uncommon and is recognized by the standard textbooks of anatomy

4 In the individual ligation technique for lobectomy of the lung it is important to demonstrate the presence of more than one pulmonary vein if devitalization of the whole lung is to be avoided.

5 If there is anomalous drainage of pulmonary blood into the major venous system the patient will be benefited by removal of the portion of lung thus drained

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# THE USE OF VASODILATION IN THE TREATMENT OF VENOUS THROMBOSIS

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THE rationale for vasodilatation obtained by sympathetic block in the treatment of venous thrombosis is that in true thrombophlebitis because of the irritative lesion within the vein impulses are set up and carried over the sympathetic nervous system to the arterioles and venules resulting in severe spasm. As we have emphasized previously (10-15) it is imperative to differentiate between two types of venous thrombosis one in which the thrombus is associated with and is dependent upon an inflammation of the vein wall i.e. thrombophlebitis and another in which the clot is a coagulation thrombus and occurs not as a result of an inflammatory process in the vein wall but because of two other factors a predisposing one consisting of increased coagulability of the blood caused by tissue damage and another, a precipitating one consisting of circulatory stasis which determines the site of the thrombus. These two types of venous thrombosis must be differentiated not only from an etiologic standpoint but also from the standpoint of their clinical manifestations, their prognosis, and their treatment. Pathologically the clot in thrombophlebitis is a white or mixed thrombus. It is firmly attached to the vein wall and will not become detached. For this reason there is little or no danger of embolism except in the rare instance in which there is suppuration and in which because of liquefaction of the clot infected emboli can become detached. On the other hand in phlebothrombosis the clot is a red or coagulation thrombus. It is not firmly attached to the vein wall and can become detached easily. The patient with phlebothrombosis is a potential fatality and, although the symptoms

are minimal or lacking there is great urgency for radical therapy. The symptomatology of the two conditions are entirely different. The patient with thrombophlebitis has definite symptoms which vary according to the location whether the deep or the superficial veins are involved. In femorofacial thrombophlebitis which is the most frequent type and which is a typical example of phlegmasia alba dolens the symptoms are maximal. There is pain and fever and the extremity is swollen white and cold. The significance of the paradoxical whiteness and coldness of an extremity in an individual with pyrexia and whose surface temperature elsewhere is increased was not previously appreciated, but is now known to be due to concomitant spasm of the arterioles. These patients although having marked symptoms, do not succumb to the disease but unless adequate therapy is instituted early have persistent sequelae which last for years months or even for the duration of their lives. In the relatively rare case of superficial thrombophlebitis there is also pain and fever. Instead of the extremity being white and swollen as it is in the deep thrombophlebitis there is redness over the involved vein and there is minimal swelling. Superficial thrombophlebitis is usually seen in conjunction with varicose veins or is associated with peripheral arterial disease.

Whereas it is our belief that the treatment of phlebothrombosis consists of radical surgery i.e. ligation of the vein above the site of the thrombus or thrombectomy and ligation after removal of the thrombus, the treatment of thrombophlebitis should be conservative with the exception of the relatively rare case in which there is suppuration.

At the outset it should be emphasized that the treatment of venous thrombosis should consist principally of prophylaxis, and it is our belief that in most instances venous thrombosis can be prevented by the minimization of

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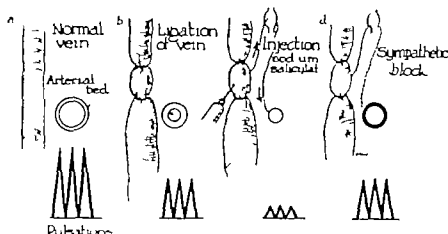


Fig 1. Diagrammatic illustration showing the effect of experimentally produced thrombophlebitis on arteriolar pulsation. a, The normal findings in the veins, the arteries, and the arteriolar pulsations as determined plethysmographically. b, The decrease in the size of the arterioles following ligation of the common femoral vein. This results in a decrease in the arteriolar pulsations. c, A marked decrease in the size of the arteriole and a marked diminution in the arteriolar pulsation, following the production of chemical thrombophlebitis produced by injecting 40 per cent sodium molybdate into the isolated segment of vein. d, The return to normal of the lumen of the arteriole and the arteriolar pulsations following the blocking of the sympathetic impulses originating in the thrombophlebitic segment. This interruption is produced by anesthetization of the sympathetic ganglion.

trauma and infection and by the speeding of the circulation in the veins of the lower extremity venous thrombosis can be greatly minimized. Only after thrombosis has occurred is it necessary that active therapy be instituted. It is a rule on our service that in all patients past forty years of age who have any tissue injury operative accidental during delivery or as the result of destruction of tissue by neoplastic disease or infection the lower extremities are wrapped with compression bandages (Ace No. 8) from the toes to the groin in order to increase the rate of blood flow through the deep venous system. The patient is also made to contract the muscles of the calf and the thigh. Tight abdominal bandages are avoided and the return flow of blood through the venous system to the chest is favored by having the patient take deep breaths. Those positions such as the Fowler's position which favor circulatory retardation of the lower extremity are avoided.

Thrombophlebitis of the deep venous system, particularly the femorotibial, is an interesting biologic phenomenon, because although the lesion is in the large deep veins, the symptoms are the result of arteriolar spasm. Where-

as previously it was thought that the pain was due to the inflammatory process in the veins, that the swelling was due to the plugging of the vein by the thrombus, and that the white discoloration was due to the lymphedema, we have been able to demonstrate experimentally and clinically that all of these manifestations are the result of vasospasm. Experimentally DeBakey, Burch, and I (3) showed that in an isolated thrombophlebitic segment of vein, impulses originate and are carried over the sympathetic nervous system producing spasm of the arterioles of the homolateral extremity (Fig 1). Subsequently we (16) showed in clinical cases of phlegmasia alba dolens that there is a very definite diminution in the arteriolar pulsation of the involved extremity which can be relieved by sympathetic block (Fig 2). Concomitant with the relief of the vasospasm there are relief of pain, prompt subsidence of the fever and disappearance of the edema. That the edema is not secondary to the mechanical plugging of the vein by the thrombus is demonstrated by the fact that ligating a vein surgically will not produce a similar edema and that the edema in thrombophlebitis will subside quickly following the

# OCHSNER VASODILATATION IN VENOUS THROMBOSIS

chemical section of the sympathetics even though the thrombus still remains. The edema in thrombophlebitis and its persistence are undoubtedly due to the associated vasospasm of the homolateral arterioles, resulting in such a marked diminution in blood flow through the capillary bed that a relative anoxia of the capillary endothelium ensues. Because of this the permeability of the capillary endothelium is increased and there results an excessive exudation of fluid to the outside producing the edema. The edematous fluid has difficulty in getting back into the vascular system for two reasons, first, because the pump which is responsible for the movement of the lymph namely arteriolar pulsation is lost because of the arteriolar spasm and, second because the pressure at the venule end of the capillary and inhibits the venule end of the capillary and inhibits absorption at this point. By overcoming the vasospasm by anesthetization of the sympathetic ganglia, the pain which is the result of ischemia is relieved and because of the prompt re-establishment of the normal circulation through the capillary bed the relative anoxia is overcome, the excessive exudation to the tissue spaces is prevented and by the re-establishment of the normal arteriolar pulsation the pump which is responsible for the movement of lymph is again brought into action and the edema quickly diminishes. Prompt subsidence of fever following novocain anesthetization of the lumbar sympathetic ganglia in phlegmasia alba dolens is probably due to the more rapid resolution of the inflammatory process in the vein wall resulting from better vascularization.

Because of the demonstration of these vasospastic phenomena associated with thrombophlebitis and their relief by anesthetization of the regional sympathetic ganglia, the treatment of phlegmasia alba dolens by sympathetic block is rational. Also the fact that these patients who would otherwise be incapacitated for weeks or months with persistent post phlebitic edema, recurrent erysipeloid infections and recurrent ulcerations are well within a few days time is additional proof of the adequacy and efficacy of blocking of the sympathetic ganglia in the treatment of phlegmasia alba dolens.

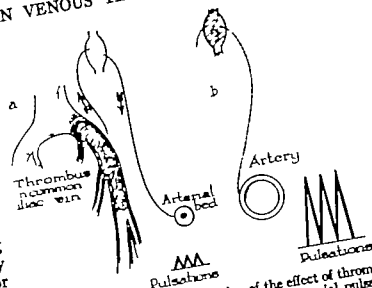


Fig. 2. Diagrammatic illustration of the effect of thrombophlebitis on the arterial bed and on the arterial pulsations. As shown in a, impulses originating in the thrombophlebitic segment, which are carried over the sympathetic nervous system to the arterial bed, produce a marked decrease in the size of the lumen of the vessel and a diminution in pulsation. b, Following anesthetization of the sympathetic ganglia, there is an interruption of these vasoconstrictor impulses, resulting in a return of the arterial lumen to normal and a re-establishment of normal pulsation.

The technique of lumbar sympathetic block is extremely simple and has been described adequately in previous reports (13-15, 4, 16-18) (Fig. 3). Although, theoretically, the employment of a single needle is sufficient it is our belief that if one uses multiple needles the block is much more likely to be successful because at best the injection is done blindly. With multiple needles the chances of striking the level in which the sympathetic chain is located are greatly increased. Because the patient with phlegmasia alba dolens is usually quite ill we prefer performing the sympathetic block with the patient in the lateral decubitus position. Points two finger breadths lateral to the spinous processes of the first, second, third and fourth lumbar ganglia are chosen. A cutaneous wheal is made. A long fine special needle  $5\frac{1}{2}$  inches in length, is used. It is important to use a long needle because otherwise the anesthetic solution may be deposited into psoas muscle. The needle is introduced perpendicular to the skin until the point hits the transverse process. The transverse process serves as a landmark, because, whereas there may be considerable difference in the thicknesses of the subcutaneous fat and the sacrospinalis muscle of a large, muscular,

unnecessary procedure when better results can be obtained more safely and more simply by sympathetic block with procaine.

### CONCLUSIONS

1 Because the symptoms and signs in true uncomplicated deep vein thrombophlebitis (phlegmasia alba dolens) are due to spasm of the arterioles of the involved extremity vasodilatation produced by section with procaine of the regional sympathetic ganglia is rational

2 Although ligation of the involved vein is imperative in phlebothrombosis and in suppurative thrombophlebitis in order to prevent emboli gaining entrance to the systemic circulation sympathetic block is sufficient in suppurative thrombophlebitis

3 By the prompt induction of vasodilatation the symptoms and signs in phlegmasia alba dolens are quickly alleviated and the postphlebitic sequelae are eliminated.

4 The use of multiple needles in performing sympathetic block greatly enhances the efficacy of the injection

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# ANTICOAGULANTS IN VENOUS THROMBOSIS AND THE PREVENTION OF PULMONARY EMBOLISM

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THE object of this paper is to discuss the effect of anticoagulants in the treatment of venous thrombosis, its prevention and the prevention and treatment of pulmonary embolism.

To approach this problem it seemed logical to consider the subject under the following headings:

1 Whether or not venous thrombosis is infective in origin. It is my impression as stated in a previous paper (7) that in only 5 per cent of the cases of venous thrombosis was infection a factor in production of the thrombus and even in these cases it is possible that the infection was a secondary invasion of a thrombus or clot which had formed from other sources. This evidence is based on the fact that in 28 cases of venous thrombosis which were operated upon cultures taken from the surrounding tissue from the wall of the vessel and from its lumen, showed no growth of organisms on ordinary cultures and aerobic cultures or on special media. The fact also that in the majority of cases if the extension of thrombosis can be prevented they clear up rapidly without further evidence of infection or suppuration lends further support to this view.

2 The beginning and extension of the thrombus. On clinical evidence, which was supported also by experimental evidence, I think it can be safely assumed that whatever may be the factors precipitating the thrombosis the lesion begins in a localized area and extends from such area as a propagating thrombus. This is well demonstrated in the cases in which the clinical signs and symptoms would indicate that the calf muscles may be the site of origin. From that point the progression of thrombosis with clinical symptoms

and signs extends through the adductor region to involve the femoral and presently the iliac vessels. In many cases at a later period the opposite leg is involved in what would appear to be a retrograde fashion. Also in the post mortem study of the vascular tree of the lungs in patients dying of pulmonary embolism, the primary embolus has been well demonstrated and on top of that has been built up a thrombus which is of more recent duration which extends more widely through the vascular tree until ultimately a fatal effect is produced—a fact which has been well demonstrated by

Professor Boyd

3 Ligation of vessels an exciting cause. There is evidence to suggest both clinically and experimentally that ligation of vessels, especially veins, may be the exciting cause for thrombosis, from which extension can occur. This is well known in operations involving dissection and removal of organs in the pelvic region where thrombosis with pulmonary embolism as a complication, is a fairly common occurrence. It has been demonstrated experimentally that if any major or minor vessel is divided tied sewn or allowed to become occluded by natural clotting and thrombosis that there is a process of thrombosis set up which extends proximally through that vessel for varying distances. In a vessel very carefully dealt with these thrombi may be only small fragments occurring in clinks in the vessel where it is gathered into a cone by ligation or where there are small irregularities from suture of the end of the vessel. However once this process is set in action it is purely a matter of accident just how far it will extend, if the other conditions favoring thrombosis are present. It is suggested, therefore that any form of surgery on the vascular tree, especially on the venous side, is not without some hazard as regards the initiation of this process of thrombosis with the unpredictable accident of pulmonary embolism as a complication.

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It would seem obvious therefore, if thrombosis and clotting can be prevented or is not initiated that pulmonary embolism cannot occur leaving out for the moment, of course fat embolism. Much has been done in the way of clinical care of patients in an attempt to prevent early thrombosis in the vascular tree and from statistics in our own hospital the incidence of thrombosis and pulmonary embolism has been considerably reduced by care of the patient on the operating table and the avoidance of many of the conditions which are conducive to thrombosis. It may be stated emphatically that with the ultimate in view if by any means including giving anticoagulants, thrombosis in the venous tree could be prevented then the solution of pulmonary embolism and the late effects of thrombosis in vessels would be eliminated. It is obvious, of course that there are difficulties and objections to giving anticoagulants with this objective. For example there are groups of patients in whom the administration of an anticoagulant must be undertaken with great caution. In the postoperative group there may be the danger of initiating hemorrhage into the wound or in the operative field. However if the surgeon has in mind that an anticoagulant may be used, if the larger or medium sized vessels are adequately dealt with by ligatures, the danger of this is exceedingly small and this danger can be reduced to an absolute minimum by the careful administration of the anticoagulant and its proper control so that the clotting times and prothrombin times are kept within normal and reasonable limits as advocated in the early studies on these subjects. As well there is the added work and difficulty required in such treatment. However with the proper control and a fine understanding of the objective and the principles, these difficulties are not insuperable and in my experience they justify the end results.

I quite agree, for example in varicose veins with localized thrombosis in a varix, that ligation with continued activity of the patient offers simple and adequate relief of symptoms and almost certainly eliminates or prevents complications such as pulmonary embolism or extension to the main vascular tree. On the other hand with widespread thrombosis

through an uncertain area, it is more difficult to know just where ligation would be effective in loculating the area of thrombosis, to prevent further embolism. In my experience the question regarding the terminology of phlebotrombosis versus thrombophlebitis rests on the knowledge of the pathology of the course of events in thrombosis in the venous tree. As every operator has demonstrated, there may be thrombosis of vessels far in advance of the area suggested by clinical symptoms or physical findings of edema, tenderness, etc. As was explained in an earlier paper I believe these effects are as stated by Dr. Homans many years ago the result of the inflammatory reaction to a thrombus which has formed some hours or days previously. These inflammatory changes provide the patient with the cause of his symptoms, and the surgeon, with the findings of thrombosis. It is obvious, therefore, that the extent of the thrombus in the vascular tree is exceedingly difficult to delineate by physical examination. Also phlebography has given only partial satisfaction in delineating the uppermost extension of such a thrombus. As the surgeon has the objective in tying vessels, of loculating the process below his figure difficulties immediately arise. It is just here that anticoagulants enter into their best atmosphere. The effect throughout the vascular tree is universal and thrombosis, no matter where it is or where its extensions may proceed comes under the influence of anticoagulants. This is just as true in the question of further extension of thrombosis when embolism has occurred in the pulmonary artery as well as in the distal tree. It also has the advantages of having its effect in preventing intracardiac thrombosis (5). Especially is it true in the prevention of thrombosis in surgery either on the arteries (6) or on the veins themselves. I have found it of very great value in doing anastomoses as first done by Blalock, and have used it in 15 cases of the Tetralogy of Fallot. In none of these patients has there been thrombosis at the site of anastomosis as far as one can determine clinically and in none has there been cerebral thrombosis or other cerebral accidents neither has there been any evidence of pulmonary or peripheral embolism.

# MURRAY ANTICOAGULANTS IN VENOUS THROMBOSIS

My evidence as regards the effect of anti coagulants on venous thrombosis and pulmonary embolism, is based on

1 Four hundred postoperative cases in which patients were treated with an anticoagulant with the objective of cutting down the incidence of thrombosis and consequently of pulmonary embolism. In this group no patient developed peripheral thrombosis and there were no cases of pulmonary embolism. Our experiment obviously includes too few cases to be of much significance except that the treatment was carried out in groups of cases in which from our hospital statistics, thrombosis and pulmonary embolism reached the highest figures recorded.

2 Three hundred and seventy-one cases of venous thrombosis in which treatment by anticoagulants was carried out with the objective of (a) preventing pulmonary embolism and (b) as treatment for the progressive thrombosis in the venous tree with a hope of relieving symptoms and of diminishing the ill effects so obvious and evident following venous thrombosis, such as persistent edema, varicose veins ulceration, etc. All these patients had typical symptoms and signs of venous thrombosis before treatment was started.

The results of treatment were satisfactory in that none of the patients had pulmonary embolism. Moreover the late effects of the thrombosis were less severe than in a control group. There was less persisting edema fewer ulcers in a 9 year period and fewer varicose veins during this time.

3 One hundred and forty nine cases of pulmonary embolism treated by anticoagulants. The cases were not selected and were obviously those which had survived the first embolism. In many of these the patients were in extremis at the time of beginning of treatment. Fifty two of these presented a state with which you are all familiar the patient in alarming shock with no palpable pulse at the wrist, bordering on unconsciousness and with all the serious and dreadful effects of massive pulmonary embolism. From an analysis of histories of a hospital together with the postmortem findings, it has been demonstrated as shown on a previous paper that about 1 in 5 of all cases surviving the first pulmonary embolism is apt

to succumb to future embolisms or from the effect of propagating thrombosis increasing the effect of the original or subsequent embolism.

This group of patients with pulmonary embolisms here reported are those over whom I had control during treatment. In these I had information that the treatment was adequate that the necessary effect on the clotting time or on the prothrombin time was obtained. I saw a fairly large number of similar cases in consultation with other doctors who undertook the treatment of the patients and for that reason these are not included in this report. I have learned subsequently of 3 deaths in this group treated by other doctors. In those in whom I had control of the treatment and knew that the adequate effects on the clotting and prothrombin times had been obtained there were no deaths from embolism in 149 cases. Four of these following the beginning of treatment, had further embolisms which were obviously small in nature because they produced only slight effects on the patient.

It is very impressive to see the effect on a patient with massive pulmonary embolism or with extensive thrombophlebitis or both the improvement that takes place in a matter of very few hours is striking once the effect on clotting time has been obtained. The pulmonary distress with dyspnea, pain etc. together with the embarrassment of heart action are diminished progressively in relatively short time so that within a few hours there is a measurable change and within 24 to 36 hours the alarming symptoms have largely disappeared. It may take several more days before there is complete relief of all symptoms.

During the course of such treatment, it has frequently been observed that there was no obvious swelling or edema of extremities at the time of the massive embolism. However, during the course of treatment one leg has enlarged and showed "quite marked edema and on some occasions at the same time, or within a few days the other leg has gone through similar changes. It is my impression from a study of the pathology that this is no indication of ineffectiveness of the treatment by anticoagulants. I believe that at the time of the embolism there obviously was a massive thrombus at some site in the venous tree

which was so insecurely attached that it broke off and floated as an embolus. However at this stage the inflammatory reaction in the wall of the vein and surrounding tissue had not reached the point where it had produced clinical symptoms. Even under the treatment by the anticoagulant, which can only prevent the further extension of thrombosis, the remaining thrombi have excited the inflammatory reaction which has gone through the changes necessary to healing of the lesion.

To accomplish this effect, in the presence of thrombosis or embolism, it is absolutely essential that the original principles of application of anticoagulants be followed. First, if heparin is administered it must be carried to the point where the clotting time in the patient is kept at or about 15 minutes. It is of no use whatever to give heparin blindly and not know that the effect is being obtained. Because the effect of heparin is so evanescent and because the dose is variable for the individual, the only safe way to be sure of this effect is to do clotting times at short intervals. The next principle is to give the anticoagulant until the healing process in the area of existing thrombosis has reached the stage where no further thrombosis will take place. From our experience in the average patient who is able to get out of bed the patient is kept at rest for 3 or 4 days under the treatment. Following this exercise is encouraged and within 6 or 7 days of the beginning of treatment the patient is urged to be out of bed and exercising actively. When the patient can go through this with some energy probably on the seventh, eighth, or ninth day the heparin treatment is discontinued. If however the patient has some lesion or operation which necessitates staying in bed then the treatment is continued for longer periods up to 3 and occasionally 4 weeks, in such cases as spinal fusion where the patient has not been allowed to be out of bed. It was demonstrated experimentally that a thrombus placed in a vessel is endothelialized well within this period of time and probably that is the best protection against further extension provided the remaining physiology of the patient has reached normal.

Dicoumarol has many advantages over heparin in the way of expense and the ease of

administration. However in my experience it is not quite as effective as is heparin, in preventing extension of thrombosis. It can be used however as an important adjunct. When the patient has begun treatment with heparin for 2 or 3 days, the dicoumarol can be added as a supplement and the patient encouraged to be ambulatory under this treatment with greater ease.

I have not used any of the thrombolytic substances in an attempt to dissolve clots. A few patients were treated with sodium tetrathionate, but not enough to determine its value. In those treated the effect seemed to be excellent.

Dr. Allen at the Mayo clinic has reported (1) a large group in which anticoagulants were administered with excellent effects. Also the group in Scandinavia, namely Zilliacus, Hedénius, Jorpes have reported large groups treated with anticoagulants with satisfaction.

One advantage of using anticoagulants also is that in a patient who is on the verge of collapse the treatment involves very little disturbance and in my experience the effect has been dramatic. This may have advantages over operative procedures where either injection or operation involves the undertaking of more active and energetic measures for which a patient may be in very poor condition.

#### CONCLUSIONS

1. Intravascular thrombosis and clotting can be prevented by anticoagulants, heparin, and dicoumarol.
2. If thrombosis and clotting have occurred, anticoagulants in appropriate doses will prevent further extension of the process.
3. If a patient is adequately treated with anticoagulants following pulmonary embolism, the chances of survival are excellent.

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# CARCINOMA OF THE COLON

## A Statistical Analysis

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**T**HIS paper represents a study of all the patients with carcinoma of the colon not including the rectum and rectosigmoid admitted to the Veterans Administration Hospital, Hines Illinois from 1931 to 1945 inclusive. A similar review is being made by other workers at this Hospital on carcinoma of the rectum and rectosigmoid. During this 15 year period this institution has been the tumor center for all Veterans hospitals of the Midwest and a large volume of material and records is available for study and analysis.

The purpose of this paper is to add to the growing number of cases being reported so that totals of statistical significance may be amassed to analyze the material and to attempt to draw pertinent conclusions. Each record of admission was studied with reference to age, duration of symptoms common complaints, important physical and laboratory findings, surgery operative and numbers and length of survivals. It is a difficult task to take a maze of data and present conclusions in a simple readable form. Follow up records are practically one hundred per cent complete because of government pension regulations and the persistent efforts of a specially created tumor registry section.

There were 131 279 admissions of all types during this 15 year period and 16 097 (primary admissions) of these were patients with carcinoma. In 1330 of these admissions, the primary lesions were in the large bowel colon, and rectum included. In Figure 1 are shown

the sites of predilection. Many writers have repeatedly stressed that two-thirds of all carcinomas of the large bowel involve the rectum and rectosigmoid and can be felt by the finger of the careful examiner. These and certain others in the lower sigmoid likely to be missed by barium enema can be seen through the proctosigmoidoscope and specimens obtained for biopsy study. Points of flexure and the cecum have a moderately high incidence considering their short span. They presumably receive the maximum mechanical and chemical trauma which might play a rôle in carcinoma of the colon.

The close similarity in the frequency of the sites of involvement in our patients with those reported by others is shown in Table I and is of biological significance.

This study concerns itself primarily with the 486 patients who had involvement above the rectosigmoid. The histories were divided into two groups before and after January 1 1941. This division is convenient because it gives data as to 5 year cures and because of the adoption of improved methods in anesthesia and in preoperative and postoperative care in the latter period. These included better colon decompression, the various sulfa drugs later penicillin, and liberal use of blood transfusions and continuous gastric suction. Their salutary effect on surgical mortality and morbidity seems clinically and statistically to have ushered in a new era in colon surgery.

In Figure 2 are given percentages of resectability for the entire period. In the term resectable are included only those cases in which a cure can reasonably be anticipated following removal of all gross carcinomatous tissue. It includes those in which adjacent resectable organs and lymph glands are involved. A non resectable lesion implies distant metastatic spread to liver lung bone brain or non removable lymph glands. In the nonresectable

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From the Veterans Administration Hospital, Hines, Illinois and the Department of Surgery Loyola University Medical School.

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which was so insecurely attached that it broke off and floated as an embolus. However at this stage the inflammatory reaction in the wall of the vein and surrounding tissue had not reached the point where it had produced clinical symptoms. Even under the treatment by the anticoagulant which can only prevent the further extension of thrombosis, the remaining thrombi have excited the inflammatory reaction which has gone through the changes necessary to healing of the lesion.

To accomplish this effect, in the presence of thrombosis or embolism it is absolutely essential that the original principles of application of anticoagulants be followed. First, if heparin is administered it must be carried to the point where the clotting time in the patient is kept at or about 15 minutes. It is of no use whatever to give heparin blindly and not know that the effect is being obtained. Because the effect of heparin is so evanescent and because the dose is variable for the individual the only safe way to be sure of this effect is to do clotting times at short intervals. The next principle is to give the anticoagulant until the healing process in the area of existing thrombosis has reached the stage where no further thrombosis will take place. From our experience, in the average patient who is able to get out of bed the patient is kept at rest for 3 or 4 days under the treatment. Following this, exercise is encouraged and within 6 or 7 days of the beginning of treatment, the patient is urged to be out of bed and exercising actively. When the patient can go through this with some energy probably on the seventh, eighth or ninth day the heparin treatment is discontinued. If however the patient has some lesion or operation which necessitates staying in bed then the treatment is continued for longer periods up to 3 and occasionally 4 weeks, in such cases as spinal fusion where the patient has not been allowed to be out of bed. It was demonstrated experimentally that a thrombus placed in a vessel is endothelialized well within this period of time and probably that is the best protection against further extension provided the remaining physiology of the patient has reached normal.

Dicoumarol has many advantages over heparin in the way of expense and the ease of

administration. However in my experience it is not quite as effective as is heparin, in preventing extension of thrombosis. It can be used however as an important adjunct. When the patient has begun treatment with heparin for 2 or 3 days, the dicoumarol can be added as a supplement and the patient encouraged to be ambulatory under this treatment with greater ease.

I have not used any of the thrombolytic substances in an attempt to dissolve clots. A few patients were treated with sodium tetrathionate but not enough to determine its value. In those treated the effect seemed to be excellent.

Dr. Allen at the Mayo clinic has reported (1) a large group in which anticoagulants were administered with excellent effects. Also the group in Scandinavia, namely Zilliacus, Hedengus, Jorpes have reported large groups treated with anticoagulants with satisfaction.

One advantage of using anticoagulants also is that in a patient who is on the verge of collapse the treatment involves very little disturbance and in my experience the effect has been dramatic. This may have advantages over operative procedures where either injection or operation involves the undertaking of more active and energetic measures for which a patient may be in very poor condition.

#### CONCLUSIONS

- 1 Intravascular thrombosis and clotting can be prevented by anticoagulants, heparin, and dicoumarol.
- 2 If thrombosis and clotting have occurred, anticoagulants in appropriate doses will prevent further extension of the process.
- 3 If a patient is adequately treated with anticoagulants following pulmonary embolism, the chances of survival are excellent.

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# CARCINOMA OF THE COLON

## A Statistical Analysis

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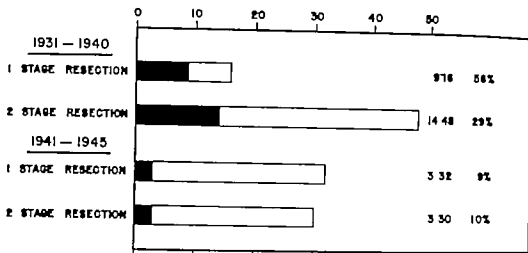


Fig. 5. Number of one and multistaged resections of carcinoma of colon and operative mortality

Resections in all segments of the colon reflects this statistically significant lowering of the operating mortality but the right half of the colon is especially favored. Pack and Livingston state that an operative mortality of 10 to 15 per cent can be expected if there is no selection of cases. However with some clinics reporting a surgical mortality of less than 4 per cent, there is ample room for improvement in our results.

Figure 4 shows the operative mortality by years. The change began gradually during 1940 and is striking thereafter. It cannot be attributed to improvement of surgical technique.

In Figure 5 it is noted that resections were done in one stage in only 25 per cent of the 1931-1940 cases, but in 51.6 per cent in the 1941-1945 group. Although the mortality in single and multiple stage procedures in the 1941-1945 group is about the same the increased number of one stage procedures possible is of great significance since it reduced the period of hospitalization from 2 months or more to 3 weeks or less, and it added to the comfort of the patient. With the present day shortage of hospital beds, the successful shift to one stage procedures is of tremendous value and is in line with the general trend throughout the nation. The good reason for the early tendency toward multiple stage procedures in the 1931-1940 period is indicated by the mortality rate of 56.2 per cent for the

one stage, contrasted with 29.1 per cent for the other.

In Figure 6 the survivals of 5 to 15 years following resections in the 1931-1940 group are shown. Of the 281 colon cases admitted in this first period, omitting those resected or explored elsewhere and sent here for routine x ray therapy or terminal care 193 candidates were left for possible resection. In 64 resection was accomplished and 21 or 32.8 per cent of the resectables are alive today. Of the resectables who survived the operation in that first period when the mortality rate was so high, 51.2 per cent are alive over 5 years. With the lowered mortality rate of the second period, it is to be expected that approximately 50 per cent of the resectables can be offered a 5 year cure and this is the approximate figure of the most successful tumor clinics. Post operative prognosis is best in right side lesions.

In 41 cases resection was done elsewhere in the 1931-40 group and the patients were sent to Hines for routine x ray therapy or terminal care. Of these 13 or 32 per cent, were alive 5 to 15 years later. Improvement in the surgical mortality rate is gradually reaching a point where for further progress the only means of obtaining more cures is to make earlier diagnoses to increase the percentage of resectables. Herein lies considerable room for improvement.

Figure 7 presents a comparison of the survival of patients following curative resection



## SURGERY GYNECOLOGY AND OBSTETRICS

TABLE II.—DATA FOR THE CONSTRUCTION OF 1931-1940 AND 1941-1945 SURVIVAL CURVES

	No. of patients with curative resections	month		year		year		3 year		4 year		5 year	
		No. survived	No. lost-lowered	No. survived	No. lost-lowered	No. survived	No. lost-lowered	No. survived	No. lost-lowered	No. survived	No. lost-lowered	No. survived	No. lost-lowered
1931-1940	64	41	64	34	64	40	64	41	64	36	64	30	64
Per cent survivors	100	64		53		63		64		56		47	
1941	20	9	10	8	10	8	10	7	10	6	10	5	10
1942	14		14	10	14	8	14	7	14	6	14	5	14
1943	3	3	3	3	3	3	3	3	3	3	3	3	3
1944	3		3	3	3	3	3	3	3	3	3	3	3
1945	3		3	3	3	3	3	3	3	3	3	3	3
1941-1945	64	55	64	43	64	40	64	37	64	34	64	30	64
Per cent survivors	100	86		67		63		58		53		47	

tumor in a higher percentage of cases than formerly

## SYMPTOMS

These patients were all veterans the majority from World War I. They were all males, the youngest was 21 the oldest 77 and in most cases the carcinomas occurred between the ages of 45 and 50 years. Symptoms were present from sudden onset to several years before a diagnosis was made. An average of 6 to 10 months passed between the onset of symptoms and hospitalization. In those found to be resectable the average duration was 6.3 months, in the nonresectable group 9.7 months. Lahey states that at that clinic the interval for all cases has been 9 months with no appreciable improvement in recent years.

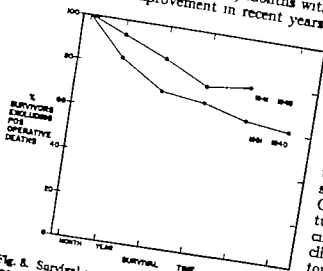


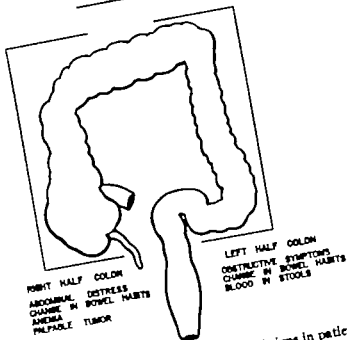
Fig. 8. Survival curves of patients surviving one month or more after curative resections for carcinoma of the colon.

There are no pathognomonic symptoms of cancer of the large bowel but sufficient warning is given to justify study which will usually lead to an accurate diagnosis. Unfortunately many patients still undergo trial medical treatment, hemorrhoidectomies, or appendectomies before diagnostic studies are instituted. The most common and suspicious complaints are enumerated as follows (Fig 9).

1. *Abdominal distress* frequently more marked in the region involved, though often enough to cause confusion, obstruction of the left colon may cause most distress in the dilated right bowel. The character of the distress varies and seems to be directly related to the degree of obstruction. It may be dull, but as the lesion tends to be located more toward the left with its semisolid stool and a tendency toward the formation of annular constricting lesions, obstructive pain occurs with colic, nausea, and vomiting. Discomfort is usually aggravated by eating and relieved by bowel movements especially if the stools are kept liquefied by cathartics. In 7 per cent of left colon lesions an acute obstruction ushered in the first sign of trouble. Fourteen per cent of splenic flexure lesions began in this manner. Gordon Heyd states that 5 per cent of sigmoid tumors begin with acute obstruction. Carcinoma of the cecum is frequently diagnosed clinically as an appendicitis, and appendectomies had been performed on 19 of the cecal cases just before admission to this hospital. Usually the surgeon recognized that there was cecal pathology present at operation.

## VYNÁLEK ET AL. CARCINOMA OF COLON

## SYMPTOMS



## FINDINGS

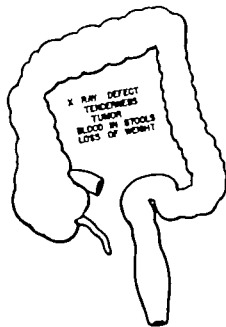


Fig 9. Symptoms and signs in patients with carcinoma of the colon.

2 *Change in bowel habits* is an important and frequent symptom elicited only by a carefully taken history. Constipation is common regardless of the location of the lesion but more pronounced and annoying in left half colon pathology. It frequently alternates with diarrhea often because the patient does himself with cathartics at regular intervals. How ever diarrhea instead of constipation may be the patient's complaint.

3 *Mass in the abdomen* was mentioned by the patient himself in 25 per cent of the cases with involvement of the cecum or ascending colon 6 per cent of the sigmoid group and rarely by others. Gordon Heyd states that 10 per cent of the people with carcinoma of the cecum discover a lump in the right side before consulting a physician.

4. *Weight loss*, contrary to the usual belief is often an early sign and is present in practically all. It may occur rapidly but ordinarily appears slowly. From 16 to 75 pounds loss of weight was common but in some patients with a violent obstructive onset there had been no previous loss.

5. *Blood in the stools* is mentioned in the histories of 33 per cent of patients with lesions in the left half of the bowel with their tendency toward the appearance of conspicuous red

blood but only 8 per cent of those with right colon involvement mentioned melena. Unfortunately the record often fails to note any questioning on this important point.

6 *Other complaints* Anemia, of an intense degree is always stressed in the literature in connection with cancer of the cecum. It is spectacular and impressive when it occurs but was uncommon in this series. The red count was usually normal even in the cecal cases until late in the disease when curative surgery was impossible. Only 13 of the 102 cecal cases had a red blood count below 3,000,000. In only 2 patients anemia and weakness were the main complaints. Of the 53 ascending colon lesions 6 had a red blood count below 3,000,000.

Indigestion, weakness, nausea, vomiting, anorexia and fever were frequently mentioned.

## FINDINGS

1 *A palpable mass* was noted at the initial examination by the Veterans Hospital physician in 81 of the 102 cecal cases, 14 of the 53 ascending colons, 20 of the 27 hepatic flexures, 26 of the 55 transverse colons, 11 of the 27 splenic flexures, 22 of the 49 descending colons, 87 of the 173 sigmoids averaging 69 per cent.

This is a rather high figure compared to that of others who mention 10 per cent to 33½ per cent as having palpable masses on the right, seldom on the left, and again indicates that many of our patients arrive late. However the palpation of a tumor does not necessarily indicate a hopeless process.

2. *Tenderness* of varying degree is frequently present at the site of involvement.

3. *Occult blood* in the stool was surprisingly seldom searched for but usually positive if the tests were ordered.

4. *Barium enema x ray studies* practically always revealed a suspicion-arousing defect which was usually properly interpreted. The segment where pathology was most often overlooked was the sigmoid in which x ray studies missed the lesion in 9 per cent of these cases.

5. *Proctoscopy* following digital rectal examination is without a peer in lesions up to 23 centimeters from the anus.

#### PATHOLOGY

Pathology was proved by microscopic studies in 68 per cent of the series. Autopsies were secured in 145 (37%) of the 390 known dead.

Adenocarcinoma or a colloid modification was the usual finding occasionally an undifferentiated carcinoma. In lesions thought by the operator to be nonresectable a large firm mesenteric gland was frequently taken for biopsy and the pathologist's report was usually negative for carcinoma. This implies that neither surgeon nor pathologist is able to diagnose cancer of the lymph nodes grossly or to differentiate from inflammation. A frozen section at operation might prevent classifying a condition as inoperable.

Operative deaths were usually due to peritonitis, embolism, pneumonia, shock and myocardial damage. One cecal case succumbed to gangrene of the terminal small bowel after resection due to thrombosis of the ileocolic artery.

Multiple polyposis was noted by the pathologist, surgeon proctologist or roentgenologist in 11 (2.2%) of the 486 patients of this study. The primary carcinoma in these cases was located as follows: cecum, 2; transverse colon, 3; splenic flexure, 1 (this patient also

had a concomitant cancer of the hepatic flexure); descending colon, 4; and sigmoid, 1.

In 3 instances in this entire series multiple cancers of the large bowel were found. Perforations into small bowel and stomach were noted in a few instances. Bladder attachment, but not perforation, was occasionally mentioned. Hydronephrosis secondary to urcinomatous obstruction of the ureter seldom occurred. Abscesses often complicated the picture, and required preliminary drainage.

#### IRRADIATION

Irradiation was used frequently as a "palliative" measure in the earlier years with no outstanding improvements. Doses of a total of 100 to 6000 roentgens are reported, but deep therapy is no longer considered of much value for lesions above the rectosigmoid. It was felt that x ray therapy following drainage of abscesses definitely shortened the period of waiting preparatory to radical surgery.

#### AVERAGE SPAN OF LIFE

In the inoperable cases death occurred 11 months after onset of symptoms, a speed which suggests a vicious process. In those having a simple exploration death occurred 6 months after operation and 16 months after onset of symptoms. Those who underwent palliative resections lived 17 months after operation. As had been shown previously the majority who died after attempted curative resections did so in the first and second years but some died of recurrence as late as 6 years following operation.

#### SUMMARY

A survey has been made of the 486 cases of carcinoma of the colon seen at Hines Veterans Hospital, Hines, Illinois, during the past 15 years. The sites of predilection are almost identical with large groups reported elsewhere. The resectability rate of 35.6 per cent is low. The drop in the mortality rate following surgery from 35.9 to 9.7 per cent in recent years is encouraging. The 5 year survival rate approaches the 50 per cent figure of the larger clinics. More one stage procedures are being done in recent years. A review of pertinent data is given.

# JORPES ANTICOAGULANT THERAPY IN THROMBOSIS

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# ANTICOAGULANT THERAPY IN THROMBOSIS

J ERIK JORPES, M.D. Stockholm Sweden

THE specific treatment of thrombosis seems to demand the use of anticoagulants. Thrombosis arises through intravascular clotting of the blood a pulmonary embolism is simply a fibrin clot detached from the walls of a peripheral vessel. In the past considerable attention has been paid by such men as Morawitz, Howell and others to the possibility of using anticoagulants to prevent thrombosis. Although heparin the natural anticoagulant of the body itself was discovered in 1916 by MacLean<sup>1</sup> working with Howell, very little benefit came of it during the next 20 years. As early as 1933 Charles and Scott of Toronto elaborated a method for large scale extraction of heparin from liver and lungs and the chemical nature of the drug was elucidated 2 years later (Jorpes). Thanks to these efforts heparin has been made available. Crafoord of Sweden and Murray of Toronto were the two surgeons first to use heparin clinically

## PROPHYLACTIC USE OF HEPARIN

During the years 1935 to 1940 it was clearly demonstrated that postoperative thrombosis and pulmonary embolism could be prevented if heparin were administered in adequate doses over an adequate length of time. In Sweden Crafoord Wetterdal and Lessner heparinized about 800 patients postoperative-

ly and in Canada Murray reported the results in treating 400 patients in the same way. Although a high incidence of thrombosis was expected 2 or even 4 per cent, practically no complications occurred. Two hundred fifty milligrams of heparin a day was found to be an adequate dosage. In the Swedish series heparin was given to 657 patients, the treatment being started on the second or third day after operation or childbirth.

Similar successful results have been reported from the use of dicoumarol Barker and his co-workers at the Mayo Clinic administered dicoumarol postoperatively to 1,000 patients and in Sweden Bruzelius treated 1,600 patients in the same way. In each series there was a marked decrease in the number of thrombotic complications.

Because of the expense involved and the risk of hemorrhage there will however, be no question about giving heparin or dicoumarol to every patient after operations or childbirth.

Prophylactic treatment with anticoagulants must be restricted to cases in which the risk of a thrombosis occurring is considerable e.g. after parturition in a patient who has had thrombosis during pregnancy or after operations on patients who have suffered from earlier repeated thromboembolic attacks after operation childbirth, or miscarriage. In such instances heparin has frequently been used in Swedish hospitals, starting with 50+50+50+100 milligrams of heparin a day at 8 12 16 and 20 hours from the second or third day onward for 5 to 8 days, until the patient is able to get up and can move about freely

Presented in the symposium on Venous Thrombosis and Prevention of Pulmonary Embolism before the Clinical Congress of the American College of Surgeons, Cleveland, Ohio, December 6-10, 1946.

For references see Jorpes, E. Heparin in the Treatment of Thrombosis, 2d. ed. New York and London Oxford University Press, 1946.



TABLE IV—THE FREQUENCY OF THROMBOSIS AND EMBOLISM AFTER SURGICAL OPERATIONS AND CHILDBIRTH IN PATIENTS ALLOWED FREE MOBILITY AND EARLY AMBULATION

Author	Place	Years	Surgical cases	Thrombosis		Fetal pulmonary embolism		
				Number	Per cent of the whole material	Number	Thrombosis	In the material
Johnsson and Holmdahl	Göteborg	1913-1944	45,376	246	54	84	34	0.06
Westerberg	Göteborg	231 1944	43,737	874	56	86	23	13
Eklund	Stockholm	1910-1944	29,000	143	73	30	21	0.06
Fallinder	Örebro	1937-1941	36,480	226	62	23	23	0.14
Zilliacus	Stockholm	1940-1945	126,524	646	51	132	204	0.09
Dahl-Iversen	Copenhagen	1942-1944	776	70	58			
Keller	Zürich	1938-1943			About 5			

only were quite without discomfort. The 13 remaining had symptoms in the leg. All suffered from swelling of the lower part of the leg in most instances moderate to severe. Five had in addition swelling of the thigh 3 had severe pain and a feeling of heaviness in the leg.

At Bauer's clinic, where all cases except those with thrombosis diagnosed before their arrival at the hospital received early heparin treatment, the process did not progress beyond the calf in 80 per cent of the cases and it stayed in the calf in all cases where heparin was given before a phlegmasia had developed. From Zilliacus's data on conservatively treated cases, it appeared that thrombosis spread to the thigh in 80 per cent of the cases. In his series of cases treated with anticoagulants—the cases presumably were not treated in the most efficient manner as far as early diagnosis and therapy were concerned—the process spread to the thigh in spite of the specific therapy in 55 per cent of the cases.

It was noted by Zilliacus that when the thrombosis had extended to the thigh there was little difference between the conservatively treated cases and those treated with heparin. Swelling of the calf with discoloration induration with large varicose veins were present in most of the cases of both groups. Ulcus cruris occurred in 11 of 154 cases treated with heparin and submitted to follow-up examination. The result in this group was the same as that among the conservatively treated cases. An important difference, however as compared with the conservatively treated cases,

was that bilateral symptoms occurred only in 3 cases instead of in 33 per cent as found among the conservatively treated cases.

The sequelae in the patients with thrombosis of the calf who were treated with heparin were generally mild. Of 130 such cases 66 were completely free from symptoms, while the remaining patients showed only swelling of the calf after exertion. Only 1 patient in this group suffered from ulcer of the leg.

The specific therapy had, thus, in cases in which the thrombosis remained localized to the calf permanently saved the patients from a chronic, painful, more or less severe, disablement.

#### THE TECHNIQUE OF ADMINISTERING HEPARIN

In most of the Swedish clinics heparin administration is started as follows: 350 to 450 milligrams a day are divided into four intravenous injections which are given at 8:00 a.m., 12:00 m., 4:00 p.m. and 8:00 p.m. or 10:00 p.m. in amounts of 125, 100, 100 and 125 milligrams. On the third day the dose is lowered, e.g. to 300 to 350 milligrams. In case dicoumarol is given on the first day heparin is omitted as soon as an appropriate prothrombin level is reached. The same scheme is followed even in case of an acute pulmonary embolism. The use of dicoumarol alone is not permitted because it has repeatedly been observed that thrombosis in the calf proceeds to the thigh in spite of dicoumarol treatment. In fact heparin treatment has aborted the disease before the full action of dicoumarol

## JORPES ANTICOAGULANT THERAPY IN THROMBOSIS

has evolved. Patients are consistently asked to move about in the bed as much as possible even on the second day and early ambulation is routine. Thus the average time in bed in Bauer's series was 4.6 days and in the other Scandinavian series 1 week to 10 days instead of 5 to 6 weeks as found in the series of patients treated conservatively.

Treatment now varies under different conditions. In small hospitals where no prothrombin analyses can be made only heparin is used. The time of coagulation of the blood is as a rule not determined. There seems to be a very small risk in using heparin without blood analyses. As to the use of heparin the contraindications seem to be very few. The risk of hemorrhages occurring is minimal. Hemorrhage is to be considered in the prophylactic treatment of postoperative cases but it has proved to be very insignificant in the ordinary treatment of leg thrombosis and pulmonary embolism.

### OTHER THERAPEUTIC MEASURES

The question arises whether similar results as those reported here also could be obtained by other means, such as through active movements and early getting up from bed. Sympathetic block causing vasodilatation in the leg and surgical ligation of the larger veins.

It is evident that exercises under medical supervision and the early getting up of patients

can reduce the incidence of thromboembolism. The incidence of thrombosis can be reduced to about 0.6 per cent in surgical clinics as is evident from Table IV.

Even in the Scandinavian series the mortality rate in thrombosis is still about 20 per cent, the same figure as that found at the beginning of this century in the surgical clinics of Germany and Austria as well as at the Mayo Clinic in this country during recent years. Consequently, there is a need for specific therapy.

The principles to be applied will at least partly depend upon the prevailing conditions. Venous ligation has in larger surgical units in this country given extraordinarily good results. In clinics where the prothrombin level of the blood can be adequately followed, dicoumarol has been used either alone or in conjunction with heparin. In all smaller hospital units, like that of Bauer in Sweden, heparin treatment can be applied successfully. It is in fact to be resorted to in every case of early peripheral leg thrombosis and in acute pulmonary embolism.

The relative value of the different methods for the treatment of peripheral leg thrombosis or pulmonary embolism will of course become the subject of closer study during the next 5 to 10 years. At present we can confine ourselves to the statement that physiology and biochemistry have given us specific means which are highly effective in the treatment of thrombosis.

# THE TREATMENT OF CHRONIC NONTUBERCULOUS PULMONARY ABSCESES BY HIGH VACUUM SUCTION DRAINAGE

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**D**URING the past few years there has been progressive improvement in the management of chronic pulmonary abscesses. Lobectomy or occasional external drainage is now being employed with excellent results. It is felt, however that in some well selected cases equally good results might be obtained by simpler means.

Often simple external drainage will fail and lobectomy despite the excellent results, remains a formidable procedure which may result in the loss of some functional pulmonary tissue which demands much of the time and energy of a skilled thoracic surgeon, an experienced anesthesiologist, and a trained surgical team as well as the services of a blood bank. No time need be spent, therefore, in advancing the desirability of a simpler method of treatment.

The purpose of this brief communication is to describe what may be such a method of treatment for certain carefully selected cases of chronic pulmonary abscess. To date, it has been employed in only 10 cases, but the results in all in which the method has had a fair trial have been so good that it seems justifiable to place the small series on record in the hope that other surgeons may be encouraged to test the method and that a group large enough to be of statistical significance may be accumulated for analysis within a reasonably brief period of time.

The method proposed is an application of the continuous high vacuum suction drainage described by Neville in 1939 for the management of chronic empyema thoracis. He was confronted with a patient slowly wasting away with chronic empyema of  $2\frac{1}{2}$  years duration.

From the Division of Surgery, Southwestern Medical College. Presented in the forum on Fundamental Surgical Problems, before the Clinical Congress of the American College of Surgeons, Cleveland, Ohio, December 6-20, 1946.

Within 4 weeks after thoracostomy and the institution of high vacuum suction drainage, the previously extensive empyema cavity had been reduced to a straight tract the size of the drainage tube, and within 7 months the patient had returned to work and was apparently completely well.

When this method came to my attention shortly after it had been described, it struck me that it might be useful in certain types of pulmonary abscess which in chronicity and other respects could be considered analogous to chronic empyema. The validity of the method as applied to chronic pulmonary abscesses seemed enhanced by a careful study of pulmonary lobes resected for this cause. In some of these cases the conclusion seemed warranted that a cure might have been obtained by simpler means, with greater economy of time and personnel, with conservation of pulmonary tissue, and with less risk to the patient.

The term chronic in this connection is used to designate that type of pulmonary abscess which has existed sufficiently long to show roentgenologically a definite fibrous tissue capsule. Not all observers, of course, would agree with this definition but as the basis of selection of cases for high vacuum suction drainage, it is an entirely adequate point of departure. If the zone of surrounding fibroplastic tissue is slight as in the type of abscess which in some quarters might be termed subacute or even acute, the abscess is given the opportunity to heal spontaneously or simple external drainage is employed. If on the other hand a considerable degree of lobar fibrosis and bronchiectasis is present, lobectomy is regarded as indicated.

The selection of cases for this method of treatment rests on still other criteria. The abscess must be single. It must be peripherally



Fig. 1. Roentgenogram taken prior to operation revealing a spherical mass peripherally placed in the lower part of the upper lobe and in contact with the parietal pleura.



Fig. 2. Lateral projection corresponding to Figure 1 showing the lesion to occupy the posterior part of the upper lobe.

located. A pleural bridge must exist, so that satisfactory external drainage can be instituted without traversing the pleural space. If malignancy is a possibility and if the usual diagnostic measures do not absolutely exclude it, exploratory thoracotomy and biopsy must be carried out. Finally the lesion must be observed sufficiently long to make certain that the cavity is not decreasing in size spontaneously or under conservative methods of treatment. If these various criteria are met, the case is regarded as suitable for high vacuum suction drainage.

The operation is preferably done under intercostal nerve block. If preliminary aspiration reveals the existence of an adequate pleural bridge the lesion is approached directly. If there is doubt regarding or definite evidence against the existence of such a bridge, exploratory thoracotomy is carried out by way of a small strategically placed incision and the site of the skin incision for drainage is determined by the location of the pleural bridge.

If no bridge is found the method of treatment contemplated must be discarded in favor of lobectomy.

The abscess cavity is entered after resection of a small segment of overlying rib and a drainage tube of appropriate size is inserted and made air tight by the use of flanges and sponges. Patent bronchial openings in the walls of the cavity are fulgurated but if this procedure be necessary suction drainage is not instituted until they have closed.

Neville described the machine which he had devised for his patient, but in hospitals equipped with built in suction systems no special machines are necessary. The suction apparatus is set at between 5 and 10 inches of mercury and the level is decreased only if the patient complains of a sense of severe pulling in the chest or if hemorrhage of serious degree occurs. The routine described by Neville is carried out with minor modifications. Thoracoscopic inspections of the cavity are made at weekly intervals and the measurements are

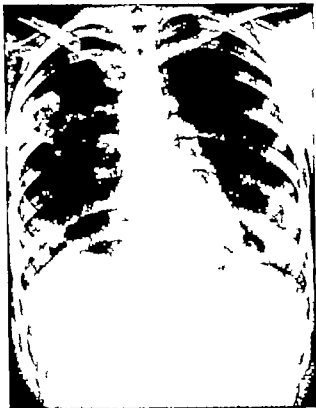


Fig. 3. Roentgenogram taken after operation shows the drainage tube passing through the resected segment of the fifth rib and the decrease in density of the lesion following suction therapy. The abscess cavity previously invisible is now quite apparent.

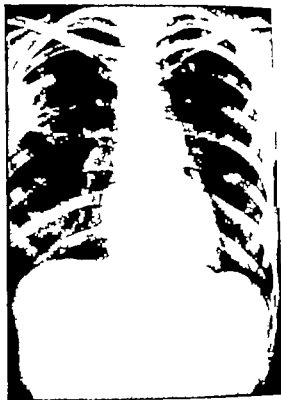


Fig. 4. At the time this film was taken the tube had been removed although the film indicates that a cavity may still be present. This is due to the peculiar arrangement of the fibrous tissue remaining in the upper lobe. The cavity has been observed fluoroscopically to flatten out against the parietal pleura and become obliterated. This patient has been asymptomatic for over 3 years and bronchograms reveal no abnormalities.

recorded at the same time for comparative purposes.

As soon as the patient is sufficiently improved to leave the hospital, he is instructed in the use of a small suction machine (available on rental from a commercial firm) which is similar to the standard tonsillectomy suction machine but is mechanically superior. It is capable of maintaining high vacuum suction for prolonged periods, with only brief intervals of nonoperation for the purpose of cooling the motor. The patient returns at intervals as necessary for observation until the abscess cavity is obliterated.

In every case in which a patient was treated by this method the clinical course has been the same. Following closure of the fulgurated bronchial orifices, if fulguration has been necessary and the institution of high vacuum suction drainage the size of the abscess cavity decreases rapidly and striking changes occur in the granulation tissue lining it. Previously

pale and edematous, it rapidly assumes a healthy appearance and many new blood vessels are observed. The sites of the bronchial openings gradually disappear and the medial wall of the cavity approaches, and finally flattens out against, the parietal pleura. This important development in the healing process is hindered when the cavity is packed but is encouraged by the suction method of treatment.

In about half of these cases suction was discontinued for periods of as long as 2 weeks, as a control measure. Invariably the diminution in the size of the cavity previously progressive, was halted and was not resumed until suction was reconstituted.

The 10 patients in this series ranged in age from 20 to 65 years, every intervening decade being represented. The duration of illness prior to treatment had ranged from 3 to 12 months. Suction drainage was necessary for

an average of 3 weeks. In no instance in the series did it fail to bring about prompt decrease in the size of the cavity eventual complete obliteration and corresponding improvement in the condition of the patient. No untoward results of any kind have been connected with its use. The earliest of the cases has been followed for a 2 year period and all other patients have been followed for at least a year. During the period of observation there has been no recurrence in any case though, because of the short time interval since treatment, the possibility of recurrence cannot be entirely discounted. Roentgenologic exami-

nation after obliteration of the abscess cavity has revealed in all cases persistence of shadows indicative of residual fibrosis.

Although the present series, as stated, consists of only 10 cases, the results secured seem to justify this preliminary report, chiefly because it is hoped that others will test high vacuum suction drainage in chronic nontuberculous pulmonary abscess and will report their results.

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## RATE OF GAIN IN STRENGTH IN SUTURED ABDOMINAL WALL WOUNDS

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**I**N recent years a great deal of attention has been given to early ambulation following laparotomy. The strength of a wound immediately following the placement of sutures depends primarily on the total number of sutures which have been placed and upon the ability of the tissues to hold the sutures as well as the tensile strength of the suture material employed and the manner of placement of those sutures. A review of the literature on wound healing yields very little reference to the rate of strength gain across incisions through the rectus muscle and fascia following approximation of the muscle and fascia with interrupted silk sutures. In the present study our objective is the determination of the amount of healing at different periods of time by measuring the tensile strength of the healing wound with non-absorbable sutures remaining in place.

According to Howes and Harvey the rate of strength gain in a healing wound resembles the curve of growth in general (4). There are 2 periods in the strength gain of a healing wound, the first, the so-called 'latent period' (2) lasts from 3 to 5 days. In the second period of the curve of normal healing strength increases rapidly and this phase continues until the wound is completely healed. Microscopically this period is associated with the process of fibroplasia (5).

#### METHODS

For the purpose of this experiment commercially raised healthy white rabbits were employed. These rabbits were maintained throughout the experiment, on a stock rabbit diet consisting of rabbit pellets and water. They were kept on this diet both before and after operation, and no attempt was made to add or subtract any dietary factor which would enhance or hinder the process of wound healing. Also no attempt was made to choose a uniform size, weight, or sex. Both medium and large healthy rabbits were employed.

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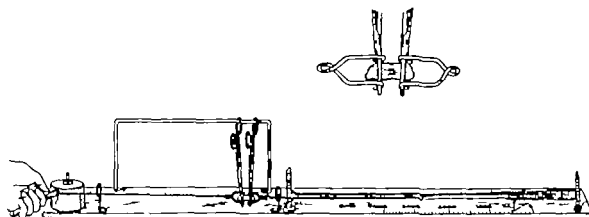


Fig. Tensiometer employed for determination of strength of tissues. The strip of tissue to be tested is gripped in two forceps which remain perpendicular to the line of tension. The tension is slowly increased by turning a large spool connected by a wire to one of the forceps on the

tissue. The other forcep is attached by wire to the spring. A rider point is moved over the calibrations on the guide bar by the stretching of the spring, and remains at the point of maximum tension. Control tissues repaired ruptured mid-ay between the clamps.

The rabbits were anesthetized by the injection of a necessary amount of aqueous sodium pentobarbital into the marginal vein of the ear. Roughly 35 milligrams of the drug were used per kilogram of weight. The hair was removed from the abdomen with barium sulfide and the skin washed thoroughly with water to remove all traces of the chemical. No marked skin reactions were observed from the use of the barium sulfide as a depilatory. Skin sterilization was obtained by the use of Novak's solution (6) and sterilization was maintained by the use of sterile towels as drapes around the operative field. Rubber gloves were not worn during the operation but operations were preceded by a 10 minute scrub with soap and water followed by rinsing in aqueous zephiran solution. Surgical instruments, heat sterilized prior to the first operation of the day were kept in a solution of aqueous zephiran 1:1000 between cases. The No. 000 and No. 0000 black silk (Deknatel) used for closure was autoclaved at 250 degrees for 10 minutes. All suture material was new and none of it was autoclaved more than once.

A midline skin incision roughly 14 centimeters long was made beginning at a point just below the xiphoid process and carried down to the lower midabdomen. This incision exposed the linea alba. At this point the superficial fascia was separated either to the right or to the left of the midline and one an-

terior rectus sheath was exposed. An 11 centimeter incision was then made through the midanterior rectus sheath, rectus muscle, posterior rectus sheath, and peritoneum, usually about 1 centimeter from the midline.

The closure of the rectus incision was made by interrupted sutures. No. 000 silk was used in some rabbits, and No. 0000 silk was used in others. The anterior rectus sheath, rectus muscle, posterior rectus sheath, and peritoneum were all included in interrupted through-and-through stitches placed at regular 5 millimeter intervals. The bite included 2 millimeters of tissue on each side, and knots were tied with one square knot just tight enough for apposition without blanching. The skin was closed by means of a continuous suture of black cotton.

The rabbits were studied at varying times during their periods of wound healing. Some were sacrificed immediately and their wounds measured for tensile strength, others were sacrificed at 24 hours, 48 hours, 72 hours, 5, 7, 9, 11, 15, 21 days and 6 weeks. No fewer than 6 rabbits were used for any single period's determinations except 9 days, and as many as 18 rabbits were used for some. In all, a total of 128 rabbits was used in this series, roughly 20 to 24 determinations were made on each rabbit, a total of roughly 2400 separate observations in all.

The rabbits were killed by the intravenous administration of 10 to 15 cubic centimeters

TABLE I — TENSILE STRENGTH OF SILK SUTURED ABDOMINAL WOUNDS IN RABBITS

Ratio of strength of wound to strength of previously undisturbed side			
Time post repair	No. of rabbits	Mean ratio per cent	Standard deviation
0	—	0	0
1 day	6	30.9	—
2 days	6	—	1.0
3 days	7	—	5.5
5 days	6	1	—
7 days	—	14.9	1
9 days	—	73	9
13 days	4	14.5	5.3
15 days	7	5.9	—
17 days	4	8	6

N.B. The tensile strength of the control sides used from 11 rabbits, but was fully observed in 12 rabbits; test in each case three animals, not exceeding two grams, and being regularly rotated with unequal width of the strips. The value of the mean value for each animal was felt to be correct for such small series. The tensile values varied in the control sides between 1500 grams and 2000 grams per cent. in different rabbits.

of air. Immediately after the animal had expired the skin was stripped from the abdomen. Careful note was made at this time of the presence or absence of any serous blood, or purulent accumulation near or on any of the wounds of the rectus muscles also any gross evidence of stitch infection.

Next the entire abdominal wall was excised and placed on a moist towel to prevent drying. This block of tissue was pinned to a cardboard beneath the towel to prevent the specimen from slipping during the process of sectioning into strips. The tissue was then cut into strips 1 centimeter in width each strip running across the midline through the intact rectus muscle on the opposite side as well. Thus each strip of tissue consisted of a portion of the rectus wound with two silk sutures in place linea alba and the previously undisturbed rectus on the opposite side. The entire transverse piece being 1 centimeter in width and about 4 centimeters long. Using a modified suture to ring device (1), the tensile strength of the midline was tested. The mean tensile strength of the sutured portions in each rabbit was divided by the mean tensile strength of the previously undisturbed portion to determine the per cent. ten-

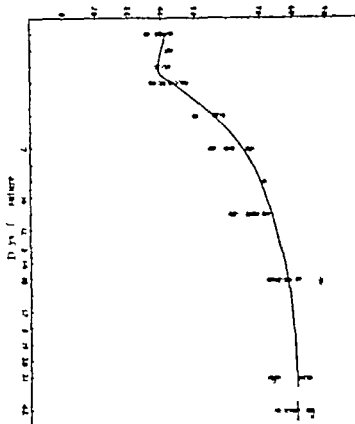
WOUND STRENGTH  
Per cent of previously undisturbed side

Fig. 2. The tensile strengths of silk-sutured abdominal wound in rabbits at various periods after repair. The smooth curve gives in most instances within 0.6 times the standard deviation from the mean from the average for each time period, and in all cases within the width of the standard deviation from the mean.

strength of the wound. Usually 10 determinations were made on each side of each rabbit. Between 4 and 18 rabbits were tested for each period's determinations. An average of all percentages was taken for all the rabbits tested at a specified period to plot the curve of wound healing.

Where there was any evidence of gross infection or abnormal appearance of the wound the rabbit was not used in the curve. Microscopic sections of all wounds tested were made and studied. Here too, when there was any evidence of infection or variation from normal wound healing the determinations were not included.

Tensiometer. We were unable to find in the literature a description of a tensiometer adequate for our purposes. One was therefore devised on the basis of the general principle employed for the suture testing apparatus.



previously reported by one of us (1). A stout spring is stretched by tenalon on the strip of tissue to be tested. The rupture tension is recorded by a free rider which remains at the point of maximum tension after rupture has occurred (Fig 1).

At the conclusion of these experiments a tensiometer of German make was found described in Sandblom's paper (8) on skin healing. It has the added factor of constant rate of increase of tension prior to rupture, and is therefore probably superior to the one we have used.

### RESULTS

The first difficulty encountered was wound infection. Routine gross examination of wounds and microscopic examination of one segment of each wound resulted in the discard of 17 animals on this basis and 1 on the basis of hemorrhage into the wound.

It was found possible to construct a smooth curve of strength gain which falls well within the limits of the standard deviations from the mean value for each time period (Fig 2 Table I).

At the completion of closure the wound with sutures present was 41.9 per cent as strong as the previously undisturbed opposite side. This value dropped very slightly during the next 3 days, and then rose sharply approaching 80 per cent at 15 days and rising significantly no more after that point.

Certain variations in these results were found to attend variations in type of suture material including catgut, and manner of placement. These are the subject of further studies by 2 of us (Carleton Nelson and John Fast) and will be reported in later communications.

### CONCLUSIONS

1. The strength at varying periods of the healing wound plus the sutures employed is of paramount interest to the surgeon in the light of the present trend toward early ambulation.

2. In rabbits, the strength of the freshly silk-closed abdominal wall wound is about 40 per cent of the undisturbed opposite side and remains at this value 3 days. Thereafter it rises steeply to about 80 per cent at 2 weeks.

3. In the 6 weeks of observation in rabbits, silk-closed wounds never regained full preoperative strength remaining at about 80 per cent of that value.

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Fig. 2.

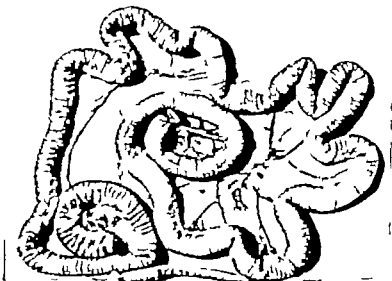


Fig. 7

Fig. 2. Close-up Kodachrome of group of adhesions showing the agglutinated talc masses appearing as white flecks within the adhesions.

Fig. 7. Kodachrome of small bowel of dog treated with powder No. 03. This shows the complete absence of any adhesions or any demonstrable inflammatory reaction.

*Experiments with Non-Irritating Glove Powder*—C. Marshall Lee  
and Edwin P. Lehman

# EXPERIMENTS WITH NONIRRITATING GLOVE POWDER

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SINCE the introduction of dry glove technique now almost universally employed by surgeons everywhere the powder used on rubber gloves has been under some degree of suspicion. But since any ill effect it might produce was masked by other more obvious factors such as infection, trauma, or suture material it attracted comparatively little attention. The incrimination of lycopodium powder as the causative agent in many granulomatous lesions and intra-abdominal adhesions is now too well known to require detailed review. The historical aspects of this subject have been ably presented by Seelig Verda, and Kidd (13). The use of lycopodium powder was rapidly abandoned in favor of magnesium silicate or talc. This inorganic material was thought to be physiologically inert in contact with living animal tissue and is now generally employed as a dusting powder for surgeons' gloves. With recognition of silicosis as an industrial disease entity some interest was aroused in the possibility that talcum powder might not be entirely innocuous. In 1933 Antopol reported 2 cases of granuloma due to talc—one in the neck and one in the serosa of the appendix. These 2 cases were mentioned in passing in a report on lycopodium granuloma and the possibility was suggested that unrecognized talc granuloma might be quite common. Feinberg reported 2 cases of talc granuloma in 1937 and for the first time employed polarized light both to demonstrate and to identify the crystals responsible for the lesions. He injected small amounts of talc suspended in saline into three mice and produced granulomas, but no adhesions, and warned against the indiscriminate use of talcum powder in the operating room.

Although scattered confirmatory reports (2, 4, 6, 10, 11) appeared in the literature, little attention was paid to them by clinical surgeons and in 1943 a second and quite comprehensive article by German (7) emphasized the danger of granuloma formation but minimized the tendency to form intestinal adhesions. In 40 of 50 unselected patients who were subjected to a second laparotomy German found intra-abdominal granulomas which he proved by means of polarized light to be the result of foreign body reaction to talc. Although there was a close parallel between the number of adhesions present and the number of granulomas the adhesions were attributed entirely to colateral causes. He stated "In the mechanism of the formation of adhesions it is well known that fibrin plays an important part. The inability of silica *per se* to induce an exudation of fibrin would suggest that it is not important in the formation of adhesions. These observations would point to a very efficient mechanism for disposal of talc by the peritoneum."

German based his conclusions on the intra-peritoneal injection of a 0.5 per cent saline suspension of talc into mice and on dry powder application in which he used only one test rabbit and one control rabbit, with and without trauma. He produced granulomas, but no adhesions. On this basis he concluded that "Talc *per se* in the abdomen in the absence of injury to the peritoneum is quickly removed from the peritoneal cavity, immobilized and covered with serosal cells, without the formation of an exudate and without adhesions. Adhesions do not develop without some form of traumatization of the peritoneum sufficient to produce exudation of fibrin. Even in the presence of peritoneal trauma and exudation of fibrin the talc plays a secondary rôle, in that it is caught up in the fibrin and is incorporated in the adhesions. Thus the developing granulomas may either add to the bulk and density of the developing adhesions or may

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TABLE I.—POWDERS USED IN STUDY

	Flow and dusting qualities <i>Raw</i>	Flow and dusting qualities <i>Autoclaved</i>
1000-D Regular amyloform (Contains 10% per cent bound HClO)	+++	++
POC treated starch (Phosphorus oxychloride)	+++	+++
05 Calcium alginate	+++	++
06 HClO treated starch (Contains about 3 per cent HClO)	+++	++
3 Raw corn starch	+++	+
04 Talc	+++	+++
3 A Tantalum oxide	++++	++++
00 Corn starch derivative	+++	+++
Corn starch derivative	+++	+++
07 Corn starch derivative	++++	++++
08 Corn starch derivative	++++	++++

\*Changes color to brownish tint

impede the resolution of any adhesions once formed. In this sense it may be said to contribute to the disability produced by adhesions resulting from surgical operations.

It remained for Seelig (12-13) to re-emphasize strongly the danger of talc as an adhesion producing agent. Although mice are notoriously recalcitrant to the production of adhesions he was able to produce generalized adhesions quite uniformly in a large series (194 mice) in which 2 cubic centimeters of a 5 per cent saline suspension of talc was injected intraperitoneally. He tested some 24 different powders and selected potassium bitartrate as a nonreactive substitute. Later he employed a starch powder which was said to withstand autoclaving fairly well. This represents the first reported use of a starch derivative for this purpose and our studies constitute an extension of Seelig's work with certain modifications in methods and materials.

In a comprehensive and detailed study Lichtman, McDonald, Dixon and Mann have shown that talc is not an inert foreign body. They point out that commercial talcum is a mixture of talc, serpentine, dolomite or tremolite. Talc itself is a hydrous magnesium silicate. "The material leached out of a talc crystal is not the same as the parent substance. The degree of hydration of this derivative substance determines its toxicity. For ex-

ample a mole of alpha silicic acid may bind as many as 300 moles of water. The size, shape, and cleavage of a talc particle and its surface energy affect its so called solubility. In the body alteration of the pH and the presence of protein in tissue fluids alter the size and characteristics of the dispersed aggregates. By means of the now common use of polarized light they conducted an extensive study of the pathogenesis of talc granulomas and adhesions, resulting from dispersed talc particles 0.5 to 10 microns in size.

The greatest barrier to the abandonment of talcum as a glove dusting powder has been the lack of an acceptable replacement for it. Many powders have been studied and the commonest single defect in those which are physiologically safe has been a tendency to gelatinize or agglutinate in the autoclave, thus defeating the primary purpose of the powder, namely to lubricate gloves and hands.

A further barrier to replacement of talcum powder has been a general failure fully to appreciate its danger. In most hospitals surgeons do not even take the precaution of washing the powder from their gloves before operating.

The purpose of our study was to verify the increasing evidence that talcum powder is a dangerous agent in human surgery and to evaluate certain proposed replacements for it.

#### EXPERIMENTAL STUDIES

*Physical properties.* Preliminary selective studies were made on the physical properties of ten powders, with commercial talc as the control.

The powders (Table I) used in this study were made available to us by the Department of Clinical Research, Ethicon Suture Laboratories, Division of Johnson and Johnson, New Brunswick, New Jersey. The first four powders have already been tried out by other investigators (7-11) and were included for comparative purposes. The last four powders, designated 100, 101, 107 and 108, are derived from corn starch which has been treated by physical and chemical means to prevent gelatinization in the autoclave. These four powders differ substantially only in degree of treatment, except that numbers 107 and 108 have

had a special chemical treatment to improve their lubricating value. The identity of the remaining powders in Table I is self-evident.

The fineness and flow and dusting qualities of the raw powders were arbitrarily classified by gross estimation from + to ++++ the latter representing the greatest freedom of flow and ease of distribution in dusting gloves and hands. Samples of each were then autoclaved under 15 pounds of pressure for 15 minutes and retested. The results are shown in Table I.

Examination of these results shows that powders 100 and 101 were about comparable to talc and that powders 107 and 108 and tantalum oxide were superior with respect to physical qualities after autoclaving. No experiments on tissue tolerance were conducted with the group of powders showing inferior physical qualities. Powder 107 was also eliminated because since No 108 was known to represent a further refinement of it detailed study became an unnecessary duplication. Tissue tolerance studies were therefore conducted on powders 100, 101, 103 A (tantalum oxide) and 108, with talcum (104) as a control.

*Method of testing peritoneal reaction.* Dogs were selected as the test animals because actual operating room conditions could be closely approximated and because the peritoneal reactions of dogs more nearly approach human reactions than do those of mice, rats, guinea pigs, or rabbits which have been used in studies heretofore reported by others. In a further effort to duplicate operating room conditions, dry powder was used in open operation rather than by injection in a saline suspension.

In every operation the abdomen was opened through a standard rectus incision. Rigid aseptic technique was employed throughout, except that before beginning the operation both operator and assistant washed their gloves thoroughly under running tap water. In every operation the small bowel was run from Treitz's ligament to the ileocecal valve. When a powder was being tested it was dusted as evenly as possible over the bowel and both mesenteric surfaces as the bowel was run. When the last loop had been handled or treated the abdominal wound was closed in layers with silk.

TABLE II.

Equivalent washings from operating room gloves	Weight in grams	Volume (in teaspoon measures)
2 pairs	0.26	1/4
4 pairs	52	1/2
8 pairs	1.024	1
6 pairs	2.01	1

After an interval of 3 weeks each dog was reopened the same technique being used and explored for adhesions. When few adhesions were found a careful count of them was made after the method of Lehman and Boys (13). When adhesions were too numerous to count they were designated +++ or ++++ denoting generalized massive adhesions.

*Quantity of test powder.* In order to arrive at a suitable quantity of powder for test purposes 4 pairs of gloves were drawn from the ready supply in the operating rooms of the University of Virginia Hospital. The outer surfaces of these gloves were washed as thoroughly as possible under a single washing with a fixed quantity of water.<sup>1</sup> The water was then evaporated and the residual powder was found to weigh 0.5262 gram. This was taken as the maximum amount of powder with which the peritoneal cavity might be contaminated by an operating team of four persons, if only one pair of gloves were worn by each and if none of the gloves was punctured.

Since the powders to be studied were of different specific gravities a volumetric measure was considered better for comparative purposes. A set of kitchen teaspoon measures was employed and approximate values were obtained for talc (Table II).

One-half teaspoonful represents the amount of talc from 8 pairs of gloves. On this basis in order to make the tests sufficiently rigorous this amount was selected as the dose to be dusted over the peritoneum of dogs. Certain exceptions to this dosage will be noted under results.

*Bacterial studies.* Although it had already been shown that the physical properties of powder 108 were not impaired by autoclaving it seemed desirable to establish that this

<sup>1</sup>It is of interest that when these washed gloves were air-dried they were still abundantly covered with a fine coating of powder.



Fig. 1. Small bowel of dog treated with talcum powder. The bowel and mesentery have been removed and laid over the end of bucket. Adhesions are so numerous and dense that the cohesive mass hangs together like a cap.

powder (which will be shown to have a high order of tissue tolerance) could in fact be effectively sterilized.

Through the courtesy of Dr Frank Meleney's laboratory at Presbyterian Hospital New York some spore threads were obtained of a highly heat resistant strain of *Bacillus subtilis*. This strain when the test tube is completely surrounded by the water will withstand boiling for 20 minutes.

A sample of powder 108 as received was autoclaved for 15 minutes at 15 pounds pressure. Culture from this sample was sterile.

A second sample was contaminated with heat resistant *Bacillus subtilis* spores and then cultured without autoclaving. *Bacillus subtilis* was readily cultured from the sample.

TABLE III.—CONTROL STUDIES—NO POWDER AND TALCUM POWDER

Type of powder	Amount of powder	Exposure, is glove washings	Number of dogs	Average number of adhesions	Greatest number of adhesions	Smallest number of adhesions
None	None	None				
Talcum Powder	1/2 Tsp	8 Frs.		++++	++++	++++
	1/4 Tsp	4 Frs.	5	++++	++++	++++
	1/8 Tsp	Fr.		+++	+++	+++

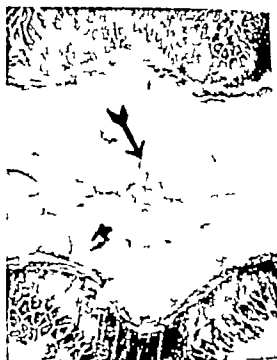


Fig. 3. Section under low power through an adhesion between two loops of bowel.

A third sample was similarly contaminated and then cultured after autoclaving. Culture from this sample was sterile.

### RESULTS

*Controls (Table III)* No adhesions resulted when no powder was used. When talcum was used dense generalized adhesions were formed. Even when the dose of test powder was reduced to 1/8 teaspoonful or roughly the washings from one pair of gloves the result was the same.

These dogs were sacrificed and at autopsy the small bowel was removed *en bloc* and formed one cohesive conglutinate mass which, when draped over the end of a bucket, sat on it like a cap (Fig. 1). The small spots of agglutinated talc were readily visible in gross under the adhesions (Fig. 2 (frontispiece)). Microscopic sections taken through sample adhesions showed the talc embedded under the adhesions against the serosa (Figs. 3 and 4). Under polarized light the identity of this material was evident (Figs. 5 and 6). The celiac and superior mesenteric nodes were greatly enlarged. Sections of these were taken to de-

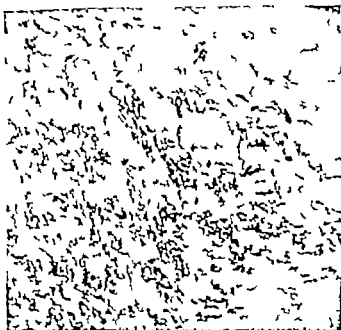


Fig. 4. Higher magnification of the area indicated by the arrow in Figure 3. This shows the inflammatory reaction and the numerous foreign body giant cells.

termine whether or not there had been any phagocytosis of the talc with deposit in the regional nodes. Under ordinary light these sections showed only the usual inflammatory lymphoid hyperplasia. Under polarized light exhaustive study showed only an occasional birefringent particle—an average of one to three a section.

*Experiments (Table IV)* Tantalum oxide produced as extensive adhesions as did talc. Further work on this powder was abandoned.

The results with powders 100 and 101 were encouraging and in the case of the latter suf-



Fig. 5. The same area as shown in Figure 4, under polarized light with partial rotation of the prism. This brings out the larger talc particles.

ficiently so to suggest testing the effect of an increased dosage. Two dogs were treated with a full teaspoonful of powder 101 equivalent to washings from 16 pairs of gloves. It is of interest that each of these dogs had been used in a previous series and the increased dose had been put in when they showed no adhesions after the first test. One dog showed no

TABLE IV — EXPERIMENTAL STUDIES—TEST POWDERS

Type of powder	Amount of powder	Equivalent in glove washings	Number of dogs	Average number of adhesions	Greatest number of adhesions	Smallest number of adhesions
Tantalum oxide	¼ tsp.	8 pps.	3	++++	++++	++++
Starch No. 100	¼ tsp.	8 pps.	5	5.7	18 (++++)*	0 (1 dog)
Starch No. 01	¼ tsp.	8 pps.	8	4	8	0 (3 dogs)
Starch No. 101	1 tsp.	16 pps.	2	5	5	0
Starch No. 106	¼ tsp.	8 pps.	10		0	0

\*One dog had an infected laparotomy wound and showed +++ adhesions. Because of this extraneous factor the average and greatest number of adhesions is taken from the remaining four dogs.

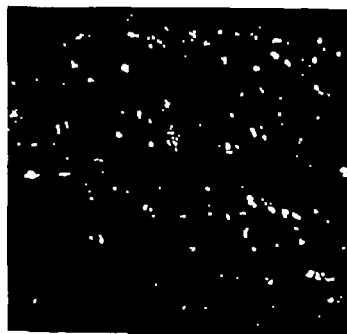


Fig. 6. The same area as in Figures 4 and 5. Here the prism has been completely rotated blotting out all but the doubly refractile talc particles.



adhesions at his third laparotomy and the other showed only five. Since powder 108 was known to represent a further refinement in processing and since its physical properties were superior the next major series was conducted with this powder. In every case when the dog was opened after 3 weeks not a trace of powder was to be found nor was there a single adhesion present. The bowel when removed *en bloc* was as clean and healthy as if it had never been touched (Fig 5). These striking results indicate the superiority of powder 108 over every other powder tested and are as good as the controls without powder.

#### CLINICAL EVALUATION

By arrangement with the superintendent of a private hospital in this city powder 108 was installed in the operating room in place of talcum without the prior knowledge of the surgeons working there. The operating room supervisor was asked to take note of any comment they might spontaneously make.

With only one exception every surgeon commented favorably having noticed the improvement in physical quality over the powder previously in use and asked what the new powder was. The single exception made no comment at all favorable or unfavorable and apparently did not notice the change.

In the course of this trial use only one unfavorable feature was observed. It happens that in this particular hospital glove powder is put up in aluminum salt shakers and used throughout the course of a day's operating schedule. Frequently these shakers are not emptied in one day and are reautoclaved and used again the next day. It was noted that while the physical properties of the powder remained unimpaired through one or at most two autoclavings there was some tendency to clump after the third such sterilization. After the fourth or fifth although the clumps were readily shaken out and fine dusting powder could be obtained from the can many residual lumps were left.

This single disadvantage seems trivial in comparison with the many advantages derived from the use of this powder and is easily obviated either by using smaller shakers or by employing the widely used technique of put-

ting up the dusting powder in individual packages with each pair of gloves.

#### DISCUSSION

It has been shown in our control studies that the atraumatic, aseptic manipulation and handling of the small bowel does not produce adhesions in healthy dogs.

When dry talcum powder is dusted over the serosal surfaces massive dense and uncountable adhesions were produced wherever the talc came in contact with the tissues. This indicates that neither trauma nor infection are required in the presence of talc to produce adhesions and the powder alone must here be held responsible. This is in direct contrast to the observations reported by German.

Furthermore our study of the regional lymph nodes indicates that at least after 3 weeks any effort on the part of the body to remove the powder via the lymphatics has been unsuccessful.

Our observations on the test powders indicate that powder 108 is completely absorbed from the peritoneum without any demonstrated inflammatory reaction and that it produces no adhesions whatever.

The fate of this powder does not offer any great pharmacological problem (3). Since it is a corn starch powder it is simply taken up by the peritoneum and metabolized like any ingested starch. Its advantage over raw starch and other treated starches is that its dusting, lubricating and flow qualities are not adversely affected by autoclaving. Its superiority over talcum powder, tantalum oxide or any other mineral, metallic or nonmetabolized powder is obvious.

MacQuiddy who has investigated the sensitizing propensities of this substance both in human patients and in animals, has failed to demonstrate under experimental conditions any sensitizing or anaphylactogenic properties. However subcutaneous tissue sections obtained by MacQuiddy indicated that in some instances at least complete absorption of the powder had not occurred at the end of 56 days. In such cases, relatively large compacted masses (up to 200 mgm) had been embedded and under such circumstances absorption might be expected to be slow and

difficult. MacQuiddy's studies are being continued and will be reported in detail at a later date

#### CONCLUSIONS

1 Further evidence is presented that talc is a deleterious substance in living tissue, that it produces a violent peritoneal reaction and dense adhesions and that its use as glove dusting powder is dangerous.

2 A commercially prepared dusting powder is shown experimentally to have

a. Excellent physical qualities of flow and fineness, unaffected by autoclaving

b. Complete absorption by the peritoneum without inflammatory reaction and without the formation of adhesions

c. Complete sterility under standard autoclaving procedure after known contamination with spores of a heat resistant organism.

3 A brief clinical trial of this powder has been entirely satisfactory

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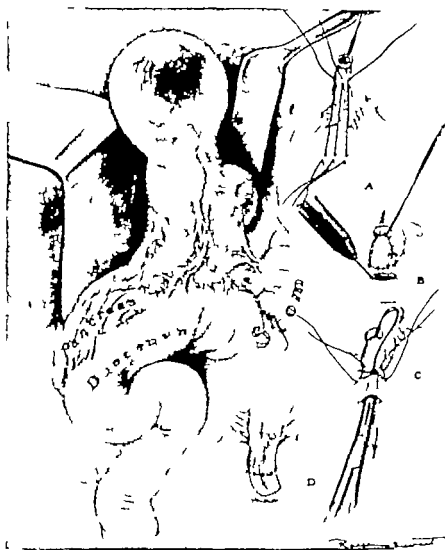


Fig. 1. Simple implantation of common bile duct. The duct is markedly dilated following previous ligation at junction of duct and duodenum. A, Posterior row of sutures placed. B, Incision made into lumen of intestine. C, Second incision made into duodenum. Hemostat placed through two incisions and ligature on duct grasped. D The free end of duct 4 to 5 millimeters in length remains extending into lumen of intestine.

*Experimental Implantation of the Common Bile Duct into the Intestine.*—Frederick M. Binkley, Robert Palmer and H. J. McCorkle

# EXPERIMENTAL IMPLANTATION OF THE COMMON BILE DUCT INTO THE INTESTINE

FREDERICK M BINKLEY M.D., ROBERT PALMER, M.D., and  
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**C**LINICAL and experimental surgical procedures in which the bile duct is implanted into the intestinal tract have been employed with increasing frequency in recent years. It is desirable that biliary intestinal anastomosis be done in such a manner as to prevent leakage of bile into the peritoneal cavity in the early postoperative period and to avert the later postoperative complication of cholangitis which often is associated with stricture at the site of anastomosis, stasis and infection of bile, and probably with reflux of intestinal contents into the biliary duct system.

In consideration of these points several types of experimental implantation of the common bile duct into the intestine of dogs were performed in an attempt to develop an efficient, simple procedure.

The experiments were divided into four main groups

1 *Simple implantation* Choledochoduodenostomy was done in 13 dogs, 8 of which had a normal common bile duct. In the remaining 5 animals the common bile ducts were ligated at a preliminary operation. Two or 3 weeks later these animals were reoperated upon and the dilated common bile ducts were implanted into the duodenum.

The technique of implantation of the bile duct into the duodenum is illustrated in Figure 1. After the bile duct is ligated and dissected free a single row of interrupted cotton sutures is placed posteriorly approximating the duodenum and the posterior wall of the common duct at a distance of 3 to 5 millimeters from the free end of the duct. The posterior row is tied under direct vision, in

order to insure accurate serosa to-serosa approximation. Two incisions are then made in the duodenum one just anterior to the suture line and with a curved hemostat which is passed through the two incisions, the common duct is drawn into the lumen of the duodenum. An anterior row of interrupted fine cotton sutures is placed completing the serosa to-serosa anastomosis. The ligature is cut from the distal end of the duct, leaving a free end from 2 to 4 millimeters in length extending into the lumen of the duodenum. The second incision is closed with 1 or 2 interrupted cotton sutures.

In none of these animals was there evidence of leakage of bile from the anastomosis in the early postoperative period. The postoperative course was not remarkable except for the urinary findings. In most animals daily urinalysis revealed the presence of bile during the early postoperative period but the urine invariably was free of bile by the 10th postoperative day. In order to determine the cause of the transient jaundice 3 animals were sacrificed on the 5th postoperative day. In these animals the common bile ducts were found to be somewhat dilated. There was considerable edema at the site of anastomosis and in the surrounding duodenum. In all cases bile flowed spontaneously into the duodenum.

The remaining 10 animals were sacrificed from 34 to 338 days after the choledochoduodenal anastomosis (Table I). In these animals the anastomosis was found to be well

TABLE I.—SIMPLE IMPLANTATION

	Normal duct	Dilated duct	Total
Number of animals	8	5	13
Postoperative duration—days	5-338	55-313	
Results of anastomosis			
Satisfactory	6	4	10
Unsatisfactory	0	0	0
Mortalities <sup>1</sup>	2	1	3

<sup>1</sup>Causes of death, anesthetic, peritonitis, etc.

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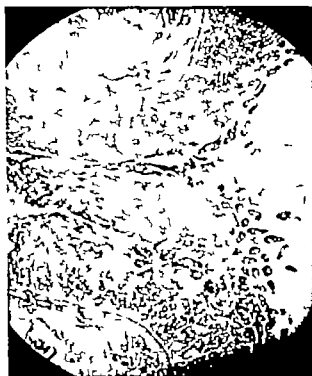


Fig. 2 Photomicrograph of anastomosis demonstrating mucosal junction, common duct and duodenum.

healed and appeared to be functioning satisfactorily. There was no evidence of stenosis. The mucosa of the common duct appeared to be continuous with the duodenal mucosa and the orifice usually lay between mucosal folds. Histological sections showed the ductal and duodenal mucosa to be directly continuous, and several histological sections revealed elevation of the duodenal mucosa about the stoma, forming a papilla like structure. There was a minimal fibroblastic response and no evidence of chronic inflammation (Fig. 2). X ray studies failed to demonstrate regurgitation of barium or free air into the extra hepatic biliary passages (Fig. 3).

TABLE II.—SIMPLE IMPLANTATION INTO BLIND LIMB OF JEJUNUM

	Normal duct	Dilated duct	Total
Number of animals	4	1	5
Postoperative duration—days	5-26	67	
Results of anastomosis			
Satisfactory	3		4
Unsatisfactory		0	1
Mortalities <sup>1</sup>			2

<sup>1</sup>Causes of death, peritonitis, ; cholangitis.



Fig. 3 Roentgenogram following simple hepatectomy. Gastrointestinal series consistently failed to demonstrate regurgitation of barium or free air into biliary passages.

There were 3 deaths in this group. Two were caused by an overdose of sodium pentobarbital used for anesthesia. One animal died with peritonitis on the 15th postoperative day but there was no apparent leakage of bile from the anastomosis. The origin of peritonitis in this animal probably was contamination with intestinal flora at the time of operation.

2. *Simple implantation into blind limb of jejunum.* In the second group of 5 animals the common duct was implanted into a blind limb of jejunum (the Roux arm principle being utilized) the same method being used as described for the first group of animals (Fig. 4). In dogs satisfactory fixation of the blind jejunal limb was difficult to obtain and the anastomoses were unavoidably under considerable tension. In 3 of the 5 animals results were satisfactory and the findings were similar to those described in the first group (Table II). There were 2 deaths. One animal died on the 3rd postoperative day with diffuse peritonitis;



Fig 4. Simple implantation into blind limb of Jejunum. A, Simple implantation of duct. B Completed procedure showing implantation into blind limb and end-to-side jejunal anastomosis.

the anastomosis was not healed and there probably was leakage of bile into the peritoneal cavity. The other animal died with acute cholangitis on the 5th postoperative day. The anastomosis was found to be healing satisfactorily with no leakage of bile. The bile ducts were filled with thick, mucopurulent exudate.

**3. Anastomosis using mechanical support**  
In a group of 5 animals a dilated (previously ligated) common bile duct was anastomosed to the duodenum over a mechanical support (Fig 5).

In 2 animals the anastomosis was done over a rubber catheter and in 3 a flanged tantalum

metal tube was used. In the cases in which a rubber catheter was used, one dog was sacrificed on the 10th, and one on the 44th postoperative day (Table III). The anastomoses were well healed and appeared to be function

TABLE III.—ANASTOMOSIS USING MECHANICAL SUPPORT

	Tantalum tube	Rubber tube	Total
Number of animals	3	2	5
Postoperative duration—days	12-252	10-44	
Results of anastomosis			
Satisfactory	3	2	5
Unsatisfactory	0	0	0
Mortalities <sup>1</sup>	2	0	2

<sup>1</sup>Causes of death: multiple liver abscesses, 1; pneumonia, 1.

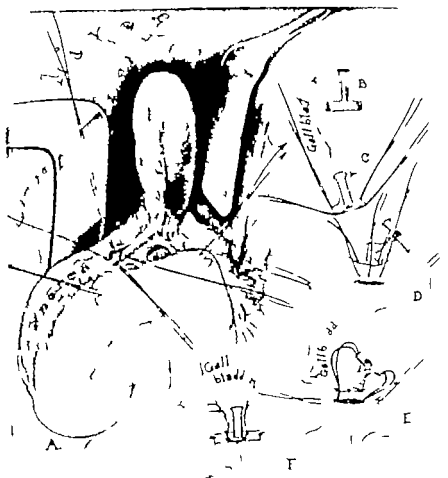


Fig 5. Anastomosis over tantalum tube. A Common duct dissected free and distal flaps constructed. B, Flanged tantalum tube. C, Duct flaps anchored to flanges of tube. D Posterior row of sutures placed. E, Tantalum tube brought into lumen of intestine and anchored into position. F Completed anastomosis.

ing satisfactorily. In one animal the duct wall was thickened and there were numerous adhesions and an increased amount of scarring about the anastomosis. Histological examination revealed a marked increase in connective tissue reaction and inflammatory response when compared with similar sections from implantations in groups I and II (Fig 6). Two of the 3 animals in which a tantalum tube was used died, one on the 12th and one on the 30th postoperative day. The former was found to have peritonitis resulting from a perforation of one of numerous liver abscesses, and the latter died with pneumonia. In both animals the anastomoses were well healed and appeared to be functioning satisfactorily and the tantalum

tubes had remained in their original position. The third animal was sacrificed on the 12th postoperative day at which time the tube was found to have passed from the site of anastomosis through the intestinal tract. The anastomosis was functioning satisfactorily. However the duct wall was thickened, and histological sections demonstrated an increased amount of connective tissue about the anastomosis with a moderate inflammatory reaction.

4. *Anastomosis using reinforced fascial tube.* In 3 animals the common bile duct was divided at its junction with the duodenum and the defect was replaced by a tube of rat fascia reinforced with a fine tantalum mesh. At a preliminary operation a rectus



Fig 6 Photomicrograph of area adjacent to anastomosis performed over rubber catheter demonstrating surrounding connective tissue reaction.

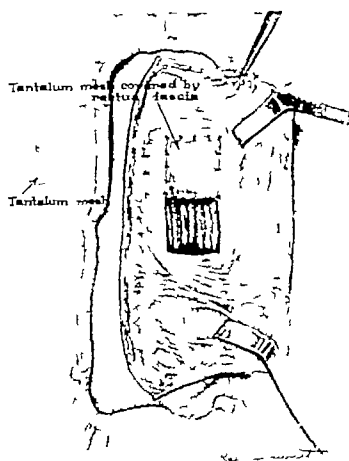


Fig 7 Construction of fascial flap reinforced with tantalum mesh. Flap of rectus abdominis sheath turned back over square of tantalum mesh and sutured into position

lar flap of rectus sheath was dissected free and folded back over a square of tantalum mesh placed upon the anterior surface of the rectus abdominis sheath and sutured into position (Fig 7). In this manner the sheet of tantalum mesh was covered on its anterior surface by the flap of fascia and on its posterior surface by the anterior wall of the rectus sheath. Two to 3 weeks later this double thickness of fascia, reinforced with tantalum mesh was excised and fashioned into a tube, which was then anastomosed at one end to a dilated common duct, and at the other end to the duodenum. The anastomosis was performed about a rubber catheter which was left extending into the duodenum and portions of omentum were brought about the anastomosis (Fig 8).

These 3 animals were sacrificed at intervals varying from 119 to 251 days postoperatively (Table IV). At necropsy the anastomoses were found to be surrounded by abundant

vascular adhesions. In all 3 animals the anastomoses were patent and appeared to be functioning however the extrahepatic biliary system was distinctly dilated. The rubber catheters were noted to have passed into the gastrointestinal tract. The tantalum mesh tube protruded into the lumen of the intestine for a distance of 2 to 3 millimeters and was almost entirely covered with duodenal mucosa. The tubes on being opened were found to be almost completely lined with mucosa, however, there were spotty areas through which the tantalum mesh was visible. A relatively thick fibrous wall surrounded the tube which

TABLE IV — ANASTOMOSIS USING REINFORCED FASCIAL TUBE

Number of animals	3
Postoperative duration—days	119–251
Results of anastomosis	
Satisfactory	3
Unsatisfactory	0
Mortality	0



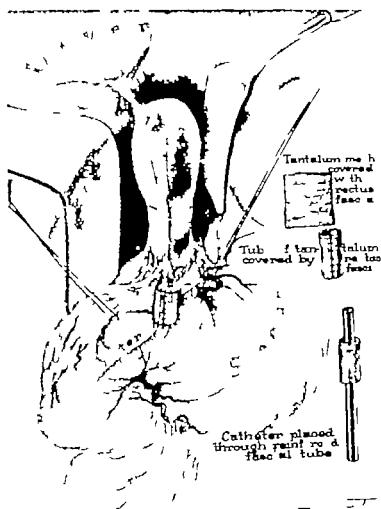


Fig. 8. Anastomosis utilizing reinforced fascial tube. End-to-end anastomosis of dilated common duct and fascial tube. Fascial tube anastomosed to duodenum over rubber catheter.

apparently was not constricted due to the presence of the tantalum mesh.

#### SUMMARY

1. A simple type of biliary intestinal anastomosis has been done in 18 experimental animals. It may be done rapidly and has given good functional results with minimum inflammatory reaction at the site of anastomosis.
2. Anastomoses employing a rubber or metal tube have been done in 5 experimental animals and these anastomoses invariably have exhibited evidence of considerable inflammatory reaction, scarring and stenosis.
3. An experimental method for the replacement of a defect in the common duct of

animals by a graft of fascia reinforced by tantalum wire mesh is described.

4. It appears desirable to use the simplest possible type of anastomosis (as described in group I) in situations where a sufficient length of the common duct remains to permit direct implantation of it into the duodenum. Use of the Roux arm principle may not be required in all instances, and might be limited to situations in which the presence or possibility of cholangitis is a factor.

5. The use of metal or rubber tubes for mechanical support in choledochointestinal anastomosis should be avoided if possible because of their tendency to produce marked scar tissue reaction with stenosis. However it

is acknowledged that there are many situations where such support is essential. In such instances temporary support with a very soft rubber tube appears preferable to more permanent support with rigid metal tubes

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## PRINCIPLES INVOLVED IN SURGICAL THERAPY OF "ENCAPSULATED" FIBROSARCOMA OF SOFT TISSUES

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IT is an established fact that success in the treatment of any malignant disease depends to a great extent upon a knowledge of its origin and course. This means that the institution of adequate surgical measures based on this knowledge is just as important as the early recognition of the presence of the malignancy. Even though it is the pathologist's responsibility in the average instance to make the actual diagnosis of malignancy when the surgeon is in doubt, it is the surgeon who has undertaken the responsibility to effect a cure. Having undertaken this responsibility it seems logical that he should be expected to possess as complete a knowledge as is practical concerning the pathological entity at hand. When this pathological entity happens to be a sharply delimited tumor found arising from the soft tissues of the body that is, from the subcutaneous tissue, muscle or intermuscular fascial planes, the gross appearance of this tumor may lead to the impression of a relatively benign process before the pathologist has had an opportunity to declare himself. It is not too unusual that the same impression may be common to both individuals even after using the time saving device of frozen section tech-

nique for histological study with the result that both are temporarily lulled into a false sense of security. Under such circumstances the definitive surgical extirpation results in a simple enucleation of an apparently encapsulated tumor from its bed of areolar tissue. The postoperative clinical impression in such instances agrees with the preoperative diagnosis of perhaps a fibroma until the permanent sections are examined by the pathologist. If the final diagnosis happens to be 'fibrosarcoma of low grade malignancy', the surgeon is faced with the problem of considering the original surgery as being adequate or of choosing a waiting game. Since tumors spread in the human body only by actual dissemination of viable cells or are manifest in more than one part of an area through a multicentric origin the correct decision in this instance will be dependent upon an accurate and full knowledge of the disease process.

#### PATHOLOGY

The histological studies of the last few decades have made considerable progress in distinguishing among the various tumors once collectively known as fibrosarcoma. In the course of this differentiation an expected amount of controversy has taken place among pathologists, out of which has arisen a fuller knowledge of the growth characteristics of

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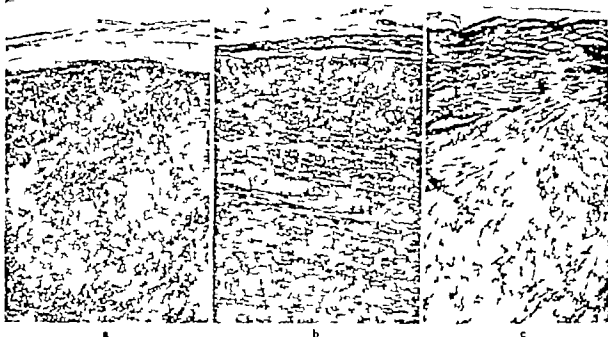


Fig. 1. Three examples of fibrosarcoma each of which presents a well defined fibrous capsule despite the variation

in cellular structure of tumor. a, Highly cellular type; b, fibrous type; c, fibrosarcomatous type.

these neoplasms. Many forms of spindle-cell sarcoma now prove on closer investigation to belong to groups of tumors arising from nerve structures, muscle fat or synovial tissue. In other words, it now appears that practically all of the sarcomas of the soft parts are derived from specialized tissue cells and not from the supporting fibroblasts. The fascial sarcomas of Virchow<sup>7</sup> thus remain as one of the few pure forms of fibroblastic sarcoma even though modified by lipomatous or myxomatous degeneration whereas an excellent example of this recent clarification is represented by the synovial sarcoma group. The synovial tissues are generally agreed to have arisen from mesodermal tissue but they normally are composed of an endothelial layer and an outer fibrous layer. The tumors arising from this tissue thus fall into two microscopic types. The first are those arising from the inner layer and are more epitheloid in character while the second are those arising from the outer layer and are usually indistinguishable from the common fibrosarcoma. On the other hand, all gradations of specialized fibroblastic tumor formation now considered as of neural origin may be obtained by a complete study of the pathological possibilities found in von Reck-

linghausen's disease with its significant incidence of malignant degeneration. Such a study reveals that the solitary neurofibroma, the neurinoma and the neurogenic sarcoma all arise from the cells of the sheath of Schwann, that is, from the connective tissue coverings of peripheral and central nerves.

Despite this microscopic differentiation all of the malignant tumors here mentioned manifest sufficiently similar gross characteristics to warrant saying that with few exceptions they present the same common problem to the surgeon. Since they present this common problem we feel justified in discussing them under the common heading of encapsulated fibrosarcoma of the soft tissues.

Most fibrosarcomas arising from soft tissues (except those of retroperitoneal and intraperitoneal origin) usually stem from subcutaneous or intermuscular fascial tissues and even though somewhat low in general incidence their gross appearance of apparent encapsulation is known to surgeons (Fig. 1). It is not uncommon to find them densely adherent to tendinous aponeuroses, thus frequently seeming to be the apparent point of origin. We have noticed that these tumors frequently encompass an occasional nerve trunk of moder-

ate size along with the accompanying blood vessel, but whether this could be considered as a demonstration of nerve origin is difficult to state without histological study. The fibrosarcoma and the synovioma have in our experience been single tumors sharply outlined from the surrounding tissues, growing expansively and conforming in outline to the area in which they lie. The neurosarcoma on the other hand may be of unicentric or multicentric origin presenting the same encapsulated or circumscribed appearance. When multiple the localized nodules arising from different parts of the same nerve may fuse with one another so that adjacent nerves running in fascia or muscle may become incorporated in the tumor process in such a manner as to give rise to a false impression of infiltration. When nerves are involved primarily or secondarily there is remarkable preservation of function.

There is no one characteristic gross appearance of these tumors as regards color consistency or size since these qualities depend entirely on the relative cellular or fibrous content as well as on the presence of internal hemorrhage, necrosis or myxomatous change which in turn may be dependent upon the primary rate of growth of the tumor. Ulceration is usually a very late finding unless the tumor growth is of such unusual rapidity that it outstrips its own blood supply.

#### RECURRENCES

It has often been stated by way of definition that fibrosarcoma is a tumor arising from connective tissue characterized by a tendency to recur after excision. Taylor and Nathanson recently reviewed 246 cases covering a period of 25 years. Of this group 62 per cent represented recurrences when first requesting their treatment and of the remaining 97 primary cases local control of the disease was effected in only half the patients. One feels that recurrence or persistence of the disease has become an accepted fact when discussing this type of tumor. It is this tendency toward local recurrences that has limited surgical effectiveness in the therapy of the disease. Were this controlled then an increasing number of patients would be salvaged before the well known blood borne fatal metastasis takes place.



Fig. 2. Fibromyxosarcoma presenting a well defined capsule with attachment to nearby muscle due to tumor cell permeation resulting in partial destruction of the capsule.

Study has shown that in general there are four different microscopic mechanisms, any one two three or four of which may be instrumental in the production of the recurrence. The first and probably most common, mechanism is that of extension of the tumor through its capsule with quite minor involvement of a nearby structure. This is far more obvious to the microscopist than to the surgeon. Although this may be overlooked in the gross specimen it may be noted on careful examination as a point of minor adherence to nearby muscle or it may occur at the apparent point of tumor origin (Fig. 2). In general these tumors grow in the direction of least pressure but despite this advantage to the host, the point of origin or any other point of attachment may present areas in which the tumor has penetrated the capsule, even dissolving it at times to invade the surrounding tissue with the capsule appearing grossly intact (Fig. 3). A pseudocapsule may even form to confuse the gross picture there being a layer of fibrous tissue thrown up in front of the advancing tumor. Such permeation of tumor cells produces a focus which if left *in situ* will be a nidus for local recurrence.

The second mechanism pertains to the factor of lymphatic spread. This is a neglected subject because lymph node involvement typically occurs late in the course of the disease, although in 1926 Hertzler reported a patient with early involvement. It has been noted as high as 8 per cent in a series of 256 cases.

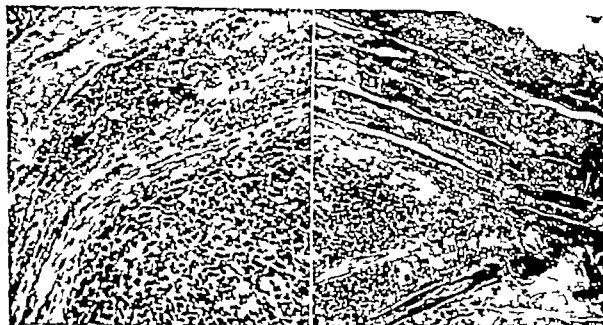


Fig. 3. a, left, Penetration of fibrosarcoma through its own capsule. b, The spread of cells at the apparent

point where the tumor had its origin from the flexor pollicis longus.

Long duration large size of the primary tumor local recurrence after excision and ulceration are prominent findings in proven instances of lymphatic metastasis. There is no doubt but that the tumor is slow to reach the larger lymphatic regional collecting depots, but the fact that such does occur must make one realize that involvement of lymphatic channels in the areolar tissue about the tumor at the time of excision is a potential hazard for recurrence. Under such circumstances local as well as distant spread of the tumor becomes more likely during the surgical procedure since many new tissue spaces are laid open to the tumor cells.

The third mechanism concerns the concept of multicentric origin of some of the tumors. This follows from the original observations made by Geschickter (3, 4) and by Stewart and Copeland. Working with neurogenic sarcoma they have noted the frequent development of a tumor after surgery higher up in the nerve trunk. Geschickter concluded that this represented an extension from the original tumor along the perineural lymphatic spaces. In the same manner he implicated the perivascular lymphatics of large vessels which were connected with the main tumor mass. On

the other hand Stewart and Copeland have considered such a neoplasm to be an independent new growth arising in the condensed segment of the same nerve, thus attributing a certain tendency toward malignant degeneration to the nerve structures. In studying the malignant changes in 466 patients with von Recklinghausen's disease, Hosoi has shed light on the problem by stating:

In résumé malignant transformation takes place in about 13 per cent of all cases of von Recklinghausen's disease. When this happens, the tumor grows rapidly and tends to recur locally even after repeated operative measures. In some cases the mere extirpation of a malignant tumor or even a benign one appears to stimulate another neurofibroma distantly located to undergo sarcomatous transformation."

The accompanying photomicrographs present an excellent example of multicentric origin of malignant neurinoma arising within the intermuscular fascial planes of the erector spinae muscle group (Fig. 4). The differential identification here lies between a lymphatic metastatic nodule lying in the soft areolar tissue surrounding the primary encapsulated tumor and a second primary neoplasm arising in a nearby branch of the same nerve from which arose the original neurinoma. Close macro-



Fig. 4. a, left, Second primary malignant neuroinoma found in areolar tissue surrounding an encapsulated neuroinoma of the back. b Higher magnification shows the

mimicry of structure including the slight fibrous capsule. The tumor apparently did not reach within a lymphatic channel.

scopic study makes the latter opinion the more tenable.

The fourth mechanism concerns the now well substantiated phenomenon of autotransplantation or implantation at the time of surgery due to spillage of tumor cells into the wound. The experience of Harrell and Volk is cited in this regard. These men reported an accidental autogenous transplantation of an ulcerated fibrosarcoma of the heel to the left thigh during the application of a pedicle skin graft. This was explained as due either to direct extension of the tumor through the graft or by accidental contamination of the incision at the donor site with tumor cells. The experience of Greene in successfully transplanting human fibrosarcoma to the anterior chamber of the eyes of guinea pigs and carrying it by serial transfer through 14 generations adds further weight to this concept.

#### TREATMENT

Before considering the application of these observations as they might be related to therapy it is of interest first to note the report of Meyerding, Broders and Hargrave covering a 20 year span in which they recorded a 3 year survival rate of 21 per cent in 132 patients afflicted with fibrosarcoma. Since it is now generally agreed that radiation therapy is of little value (1, 12) the obvious conclusion to be drawn from such a pessimistic report as well as our own experience is that the primary surgical attack on these tumors appears to be

inadequate in many instances. For these tumors located in the extremities one might easily conclude that the percentage of cures could be increased by routine amputation but closer examination of a large series of cases reveals that this would result in an unnecessarily large number of amputees without materially lowering the death rate. Thus Meyerding and his co-workers reported that of 28 cured patients in their series only 6 had amputations performed. There is no doubt but that amputation is absolutely mandatory when complete excision is impossible, when deep nerves or vascular trunks appear to be involved or when recurrence has taken place for the first or second time. Even in this last mentioned group where recurrence has taken place, Meyerding reports but five cures in 34 instances where amputation was performed in the absence of demonstrable metastases. We realize that proper evaluation of available statistics on amputation for these tumors is difficult because of the previous inaccurate histological differentiation and also since this maneuver usually has been reserved for the advanced cases, but nevertheless the procedure does not seem to fit all the requirements for the patient requesting primary care.

The answer to this low rate of cure seems to lie in the performance of a more complete local excision at the time of the first surgery. In a negative way this means that the tumor should not merely be shelled out of its connective tissue bed. In a positive way this

means that the tumor and its areolar tissue bed plus any attached muscle, nerve, or blood vessel should be excised *en masse*. Blunt dissection here is not the answer. In reviewing the operative reports concerning the removal of some of these tumors, we have noted that the tumor frequently was shelled from its bed down to an apparent point of origin or at least to a point of attachment from which it was cut free with a scalpel. Because of the lymph drainage within a muscle, it is felt that partial excision of muscle may be inadequate when a muscle belly appears to be invaded. In such instances our experience would lead us to suggest that complete extirpation of the muscle or group of muscles is far superior to a recurrence. Section of nerve trunks and ligation of vascular highways should best be performed as far as possible from the tumor. If involvement of these structures presents insufficient indication for amputation then the least we can advise is wide excision and restoration of nerve continuity with fresh autogenous or homogenous grafts. The logic of such a procedure has been clearly demonstrated (2). With the more prevalent ability in skin grafting there seems to be no excuse for allowing any possibility of recurrence by cutting too close to the tumor when excising overlying skin.

#### APPLICATION OF SURGICAL EXCISION

From the practical standpoint these generalities, if accepted, must be reduced to terms of procedure for the individual patient. In other words some consideration must be made concerning the incision to be used as well as the part to be played by the pathologist if needed in establishing the diagnosis. These steps must be carried out with sufficient ease and safety to allow for the most efficient surgical extirpation possible. Our feeling at this time is that most tumors found in the areas mentioned eventually are proved to be malignant following microscopic study. Very few instances of purely benign tumors can be found among such a group except for the fibromas with their characteristically long history and small size and the lipoma which is quite easily identified. Wilson found that 90 per cent of 111 specimens of fibrosarcoma measured over 5 centimeters in greatest diam-

eter while the same percentage of fibromas measured under 3 centimeters. Such information may be helpful but not unless correlated with duration and rate of growth. Certainly any small subcutaneous nodule which has persisted for years and which suddenly begins to grow rather rapidly will be suspected of malignant change before it reaches the critical size of 5 centimeters.

If the diagnosis is obvious a more vigorous attack can be planned at the earliest phase of the surgical intervention. There is no doubt but that the element of surgical judgment is prominent in such a matter and for the sake of clarity it is logical to liken this problem to that of breast carcinoma. In many instances the experienced surgeon can with the fullest justification proceed with his radical mastectomy without the aid of a frozen section because to him the pathological diagnosis is quite evident while in other instances he will rely upon the microscope following a local excision before going on with the more radical procedure. Unfortunately the pathologist finds himself at a disadvantage with the frozen section technique when attempting to diagnose some of these tumors without the use of special stains. Theoretically this very practical procedure loses some of its utility but this does not mean that it should be omitted from our armamentarium when we are in doubt, for it can establish in a general way the degree of malignancy that an individual tumor may possess. By this we mean that a "mad dog" type of tumor can be differentiated from a "sleeping dog" type irrespective of the cellular origin. The relative proportion of cells to fibrillar intercellular substance is probably the best single criterion for estimating the degree of malignancy in these tumors.

#### SUMMARY

The high mortality rate in patients afflicted with fibrosarcoma presents a severe challenge to the surgeon. Some of these patients probably never will be cured but many can be salvaged by preventing fatal blood-borne metastasis. This form of metastasis appears to be related to the incidence of local recurrence more than to the incidence of the disease. The local extirpation of the disease thus becomes

of paramount importance. Since the tumor frequently occurs in the extremities the question of amputation also must be considered among the methods of obtaining local control of the disease. At the present time we feel reluctant to advise amputation when a satisfactory local excision can be first achieved but on the other hand if a careful evaluation of the speed of growth the size location and histological nature of the tumor would warrant it amputation should be carried out as the procedure of choice. If the tumor presents as a recurrence, it is highly likely that a high amputation should immediately be advised unless a more adequately wide excision could still be performed. In such instances, the size of the resulting defect should not be a barrier for adequate excision as long as proper skin replacement can be achieved. It is not possible to outline typical procedures to be followed for each instance but we are impressed with the

fact that the successful outcome in most instances will be determined by the procedure used at the time of the first surgical intervention

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# PANCREATIC REFLUX DELIBERATELY PRODUCED

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THE importance of biliary-pancreatic reflux as an etiological factor in the production of acute pancreatitis or acute cholecystitis has been amply demonstrated in recent years (1 3 5 7 8 9)

In the past, pancreatic reflux was demonstrated in about 25 per cent of patients in whom a tube was placed in the biliary tract at operation (2 6) The diagnosis was based on two methods (1) the finding of pancreatic enzymes (notably amylase) in high concentration in the bile recovered from the tube drainage and (2) the visualization of the pancreatic duct when iodized oil was injected into the tube draining the biliary tract

These observations frequently depended on a fortuitous conjunction of events. As a rule pancreatic enzymes could be found in the bili-

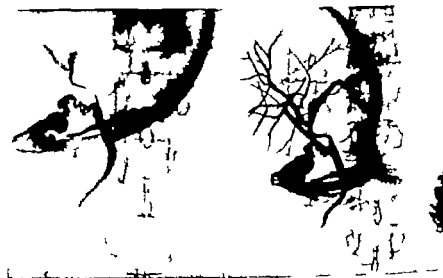
ary drainage only occasionally usually after meals (2) but sometimes only in samples obtained late at night (Table I). Similarly the pancreatic duct could be visualized during the performance of a cholangiogram only during such accidental periods when the pancreas was not secreting and when in addition the splenic

TABLE I—AMYLASE CONCENTRATION (PER 100 C.C. GLUCOSE) IN 7 TUBE DRAINAGE BILE OBTAINED AT 2 HR. INTERVALS FOR 24 HRS

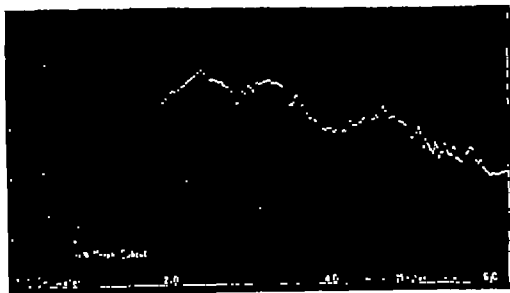
Time of bile collection 1 hr. interval	Days after operation	
	27	28
Noon		
2:00 p.m.		
4:00 p.m.	0	0
6:00 p.m.		0
8:00 p.m.		250
10:00 p.m.	0	100
Midnight		60
2:00 a.m.		
4:00 a.m.		
6:00 a.m.	888	600
8:00 a.m.	930	475
10:00 a.m.		

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Figs. 1 and 2. Before the administration of morphine (Fig. 1) the injection of iodized oil fills out the common duct, then runs into the duodenum. Only the terminal parts of the hepatic duct are outlined. Two minutes after subcutaneous administration of morphine, the continued injection of iodized oil results in the visualization of the whole biliary tract. This is due to the increased resistance of the sphincter of Oddi.





Figs. 6 and 7. Injection of iodized oil shows considerable spasm of the sphincter of Oddi (Fig. 6, left) since the hepatic ducts are outlined to a considerable extent before the oil passes into the duodenum. At the same time, a portion of the pancreatic duct (arrow) is filled. The junction of the common and pancreatic ducts at the ampulla of Vater is clearly visualized. Following the administration of morphine (Fig. 7) the whole biliary tract is outlined. The increased turgidity of the duodenal wall as a result of morphine action causes compression of the intramural portion of both the common and pancreatic ducts. The ampullary junction of these ducts are, however, still clearly outlined (arrow).

following case (Fig. 6) one can clearly see the submucosal junction of the two ducts. Two minutes after the injection of morphine (Fig. 7) the whole biliary tract is outlined due to spasm not only of the sphincter but of the duodenal wall through which both ducts pass.

When the bile and pancreatic ducts are connected by a fully unobstructed passageway as in the following unusual case (Figs. 8 and 9) which Dr. Ralph Colp of The Mt. Sinai Hospital kindly allowed me to study, passage of pancreatic juice into the biliary drainage was



Figs. 8 and 9. Injection of iodized oil reveals a hugely dilated choledochus and markedly dilated tortuous pancreatic duct (Fig. 8). The narrow submucosal junction of the two ducts is clearly seen (arrow). Another view (Fig. 9) outlines the whole dilated pancreatic duct as far as the tail.



Fig. 10. Simultaneous collection of T tube bile drainage (5 tubes on left) and duodenal drainage (5 tubes on right) following the injection of secretin in the case illustrated in Figures 8 and 9. The first tube contains drainage of the 10 minute control period, and the following consecutive tubes drainage of 10, 20, 40, and 60 minutes after secretin stimulation. Note the variations in the density especially of the T tube drainage, due to spurts of almost water clear pancreatic juice mixing with the bile.

of quite frequent occurrence. When secretin was administered intravenously to produce pancreatic reflux under controlled basal conditions, it was found (Fig. 10) that about half the pancreatic juice passed into the duodenum while the other half passed up the common bile duct. Gushes of almost water clear bile (containing pancreatic juice) would

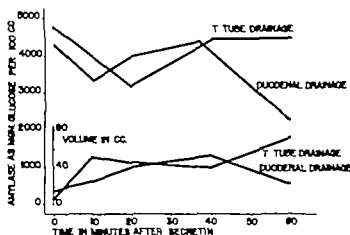
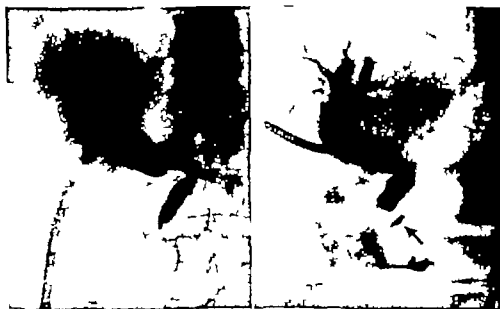


Fig. 11. Concentration of amylase in T tube and duodenal drainage following the intravenous injection of secretin in the case illustrated in Figures 8, 9, and 10. The variations in the amylase content of the two drainage fluids appear to be related to the changes in the volume of secretion.

alternate with darker bile coming unmixed from the liver. Similarly the duodenal drainage contained occasional traces of bile but frequently was water clear. The composite result depended on the resistance of the sphincter and the volume of secretion at various intervals.

When this drainage material was examined for amylase (Fig. 11) it was seen that the concentration of amylase was approximately equal in the biliary and the duodenal drainage. The



Figs. 12 and 13. Injection of iodized oil in this case in which amylase was recovered in the T tube drainage, revealed a moderately spastic sphincter and a dilated common bile duct (Fig. 12, left). The pancreatic duct (arrow) was visualized following the injection of morphine, only after two previous failures (Fig. 13).

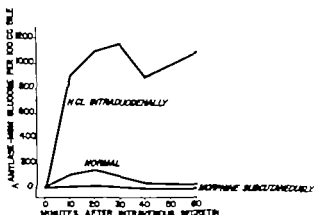


Fig. 14. The optimum conditions for the production of pancreatic reflux. In this case (Table I and Figs. 2 and 3) the injection of secretin was followed by the appearance of amylase in low concentration in the bile and so minute samples only. Morphine stopped all reflux due to spasm of sphincter of Oddi and duodenal wall. Hydrochloric acid intraduodenally produced spasm only of the sphincter and resulted in a maximum reflux of pancreatic juice.

small differences being due to variable admixtures of bile.

However, in most cases of pancreatic reflux, amylase was found in the biliary drainage quite infrequently and the pancreatic duct was visualized only after producing spasm of the sphincter of Oddi by means of morphine.

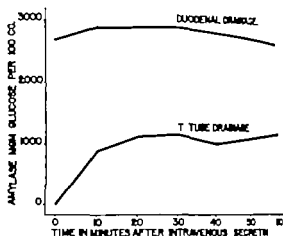


Fig. 5. The relative concentrations of amylase in the T tube drainage and in the duodenal drainage following spasm of the sphincter of Oddi produced by intraduodenal administration of hydrochloric acid (see Fig. 14). This indicates that about one third of the biliary drainage consisted of pancreatic juice.

In the following case (Figs. 12 and 13) the pancreatic duct was visualized by injection of iodized oil only after the third attempt, and amylase was found in the bile after six samples of bile were analyzed.

Accordingly the patient was given intravenously a standard dose (80 clinical units) of



Figs. 6 and 7. The optimum conditions for visualization of the pancreatic duct. Iodized oil was injected into the biliary tract in a patient who had been fasted, had all stomach contents aspirated by Levine tube suction for 4 hours previously and had received subcutaneous injection of  $\frac{1}{6}$  grain morphine 1 hour previously—note complete filling of pancreatic duct (arrow). Slight rotation of the patient (Fig. 7 right) clearly reveals the anatomical relationship of the two ducts and their junction above the sphincter of Oddi.

secretin and the biliary drainage collected at 10, 20, 40, and 60 minute intervals (Fig. 14). Amylase was recovered only in the 10 and 20 minute samples. When morphine was given just before the injection of secretin no amylase was recovered due to the fact that the spasm produced by the morphine involved not only the sphincter of Oddi but also the duodenal wall, shutting off any reflux. In a third procedure a duodenal tube was passed and following the injection of secretin intravenously 20 cubic centimeters of one-tenth normal hydrochloric acid was introduced in the duodenum every 10 minutes. This produced spasm of the sphincter but not of the duodenal wall and as can be seen a large amount of pancreatic juice (as represented by amylase) was recovered in the biliary drainage. The concentration of amylase recovered in the bile as compared to the concentration in the duodenal contents (Fig. 15) showed that one third of the biliary drainage consisted of pancreatic juice. There can be no question that such procedures which control both the flow of pancreatic juice and the resistance of the sphincter of Oddi will result in the discovery of the maximum incidence of pancreatic reflux.

Similar principles were applied in the visualization of the pancreatic duct by iodized oil. Since two main factors food and hydrochloric acid, stimulate the secretion of pancreatic juice, the patient was fasted and a Levine tube was passed 2 hours prior to x ray examination

for continuous suction of the stomach contents. To control the resistance of the sphincter of Oddi, morphine,  $\frac{1}{6}$  grain, was given one hour prior to the cholangiographic study. As the kymographic tracing in Figure 3 demonstrates 1 hour after morphine injection the resistance of the sphincter falls almost invariably to about 200 millimeters of water. By this time the spastic effect of morphine on the duodenum has worn off. When iodized oil was injected into the common bile duct under such conditions the whole pancreatic duct was visualized (Figs. 16 and 17).

#### CONCLUSION

Therefore it can be seen that control of pancreatic secretion and control of the resistance of the sphincter of Oddi by various means can be utilized to diagnose pancreatic reflux after operation on the biliary tract. Similar methods are being developed now to diagnose this condition on the operating table.

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## THE EFFECT OF EARLY POSTOPERATIVE RISING ON THE RECURRENCE RATE OF HERNIA

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THE original article on this subject was written by Ries, a gynecologist in Chicago in 1899. He was impressed by the rapid return of strength in the patients who rose early after operation and he noted the lack of unfavorable complications resulting from early rising. Although the practice of early postoperative rising was taken up by many of the European surgeons it was not widely used in this country until interest in the subject was stimulated by Leithauser of Detroit in 1941 when he published a series of 436 cases. Since the publication of Leithauser's first article there have appeared a number of clinical reports on early postoperative ambulation.

In June of 1942 a critical investigation of early postoperative rising was undertaken at the Peter Bent Brigham Hospital (1). This was to study what effect early ambulation has on postoperative complications, and whether it has any effect on the late operative results. Since postoperative complications are most common among patients having major intra-abdominal surgery this group was used to test the effect of early postoperative rising on postoperative complications. Two hundred and thirty-eight such patients who had risen on the first or second postoperative day were compared with 443 patients who got up after the seventh postoperative day. Our pertinent conclusions of that study were that the incidence of atelectasis was slightly lower in the early rising group (4.6% compared with 6.3%) and that the incidence of deep-leg vein thrombophlebitis however was slightly higher in the early rising group (2.9% compared with 1.8%). With respect to the incidence of postoperative wound disruption there was a slight reduction in the early rising group (1.3% against 2.7%).

From the Peter Bent Brigham Hospital, Surgical Service.  
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Today we present the results of a controlled study to determine the influence of early postoperative rising on the recurrence rate of hernia. The control group consists of 201 various herniorrhaphies on 177 patients. These patients got out of bed on the seventh to the fifteenth postoperative day. They were followed from 6 months to 7 years. The test group consists of 174 herniorrhaphies in 139 patients. The majority of the test group rose on or before the first postoperative day: 11 patients rose on the second day. They were all followed from 6 months to 4 years. Interrupted, fine silk technique was used in all cases of both groups.

The technique of getting the patient out of bed is essentially the same as Leithauser's. On the morning following operation the patient is turned on the side operated upon. He flexes his hips and knees so that his lower legs are at the edge of the bed. The nurse locks her elbow in the patient's elbow and the patient pushes his feet off the side of the bed as the nurse assists him up sideways to a sitting position. As the patient sits on the side of the bed slippers with heels, or shoes, are put on before he stands on the foot stool. While standing he is encouraged to breathe deeply and to cough several times. The patient then walks around the bed and sits in his chair for about 20 minutes. As he returns to bed, the walking and coughing are repeated. He is assisted out of bed in this manner twice daily until he can get up himself which in cases of herniorrhaphy is usually on or before, the third postoperative day. If the patient wishes to get out of bed on the day of the operation, he is allowed to do so unless there is some specific contraindication. Many of the patients who had had herniorrhaphy performed under local nerve-block anesthesia, got out of bed to eat lunch on the day of operation.

There was no selection among the patients who rose early following herniorrhaphy. The

TABLE I.—THE RECURRENCE RATE OF INDIRECT INGUINAL HERNIAE

Type of operation	Non-early risers		Early risers	
	Number	Recurrence	Number	Recurrence
Halsted	37	3	30	3
Bassini	85		7	
Other	Ferguson 1 McVay 1 Other		Ferguson 1 McVay 7 Orchiectomy 3 Others	
Totals	122	(3.3%)	37	(4.1%)

TABLE II.—THE RECURRENCE RATE OF DIRECT INGUINAL HERNIAE

Type of operation	Non-early risers		Early risers	
	Number	Recurrence	Number	Recurrence
Halsted	7	5	22	4
Bassini	18		10	
Others	McVay 1 Galle 1		McVay 3 Orchiectomy	
Totals	25	(6.0%)	32	(4.3%)

group includes older patients patients with poor abdominal wall structures, and patients who had all types of anesthesia and operative repairs.

As a group, the early risers were somewhat older because the younger patients were in the Army during the period when most of the early rising patients were operated upon. As we review the two groups we are again impressed by the rapid postoperative recovery which is found to be present among the group of early rising patients.

In comparing the recurrence rates in the two groups, the results are classified with respect to the method of operative repair<sup>1</sup> and the type of hernia, that is indirect direct femoral incisional and umbilical. Indirect inguinal hernia according to Watson's monograph, carries a recurrence rate of 5 to 10 per cent. Shelley in an exhaustive study of over 1600 indirect inguinal herniae at the New

<sup>1</sup>The Halsted repair refers to Halsted's modified repair in which both the conjoined tendon and the external oblique fascia are sutured below the spermatic cord so that the cord is transplanted into the subcutaneous tissue and the external ring approximates the internal ring in position.

TABLE III.—THE RECURRENCES IN FEMORAL, INCISIONAL, AND UMBILICAL HERNIAE

Type of hernia	Non-early risers		Early risers	
	Number	Recurrence	Number	Recurrence
Femoral	8		6	
Incisional				
Umbilical	3		7	

TABLE IV.—TOTAL RECURRENCE RATE OF INGUINAL HERNIAE

Type of hernia	Non-early risers			Early risers		
	Number	Recurrence	Per cent	Number	Recurrence	Per cent
Indirect	122	5	3.8	37	3	4.3
Direct	25	6		32	4	
Totals	147	11	6	69	7	6

York St. Luke's Hospital found a recurrence rate of 7.2 per cent.

Table I gives a tabulation of the recurrences in indirect inguinal herniae. It shows that in the non-early rising group there were 5 recurrences in 131 operations and that in the early rising group there were 3 recurrences in 114 operations. This is a recurrence rate of 3.8 per cent in the non-early risers and 4.3 per cent in the early risers.

For direct hernia, Watson gives the recurrence rate as between 10 and 20 per cent. It may even be higher. As recently as 1942 Page reported a recurrence rate for direct hernia of 35 per cent.

Table II presents a tabulation of the recurrences for direct inguinal herniae which shows that, in the non-early rising group there were 6 recurrences in 49 repairs. In the early rising group there were 4 recurrences among 36 repairs. This is a recurrence rate of 12.2 per cent in the non-early risers and 11.1 per cent in the early risers.

The recurrences in the few femoral incisional and umbilical herniae are listed in Table III. This shows no appreciable increase in recurrences in this small group as a result of early rising.

Table IV gives the total recurrence rate in inguinal hernia. It is seen that the recurrence rate in 147 inguinal herniorrhaphies treated



by postoperative bed rest is 61 per cent whereas, the recurrence rate in 150 inguinal herniorrhaphies treated by early rising is 60 per cent.

#### CONCLUSION

We conclude from these data, that early postoperative rising exerts no significant effect on the recurrence rate of hernia

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# THE USE OF THE MALE SEX HORMONE IN WOMEN WITH BREAST CANCER

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WE have now arrived at the point where it has become profitable to pursue the use of hormone therapy in certain types of human cancer. Huggins made one of the most important contributions that have been made in many years in the field of cancer when he was able to produce 25 per cent cures in prostatic cancer—a disease widely recognized to have an extremely high mortality. His study of the hormone influence in this disease naturally suggested exploration of other fields where cancer is either produced or materially influenced by the sex hormones. Beside the prostate it is patent that other organs such as the breast, uterus, ovaries, adrenal testes and thyroid should each receive serious attention and experimentation.

I recently made a study of 5000 cases of early breast cancer relative to their ages at the time of the development of their cancer.

The peak of the greatest number developing cancer was 45 years. This age probably represents the time when certain chemical changes are present deviating somewhat from the normal ovarian hormone. The ovaries are undergoing at this age certain changes leading up to the menopause which comes on at an average of 46½ years.

On the other hand, the year when next to the greatest number develop breast cancer is age 60 years and here we probably have a patient who has practically no ovarian hormone output. It is possible that the 13 or 14 years since having a definite ovarian function as evidenced by menstruation may represent a complete lack of ovarian hormone output and may represent a possible cause for the production of breast cancer in the older age group. This theory fits well into the fact that

the women of 60 years and older with breast cancer are improved by the use of the estrogens.

During the past several years my department has been making a clinical experimental study on approximately 200 cases of cancer of the female breast in which testosterone propionate has been employed.

In the beginning the results of this therapy when using small amounts seemed to be of no value (Farrow and Woodward). I next treated 48 patients in my private practice employing a daily dose of 25 milligrams intramuscularly to each patient (175 mgm weekly). It soon became obvious that in certain cases of advanced breast cancer and more particularly in those metastatic to bone, that we were dealing with a very potent agent capable of producing striking clinical improvements as well as changes some of which were demonstrable by x ray films.

Up to this time we had been hampered in our clinical research by the high cost of testosterone propionate, and at this juncture Dr. Henderson of the Schering Corporation generously made it possible for us to commence our new attack employing large doses.

Dr. Julian Herrmann and I then began by giving some patients as much as 100 milligrams daily by intramuscular injections of the agent in oil. We varied the dose using in some instances the testosterone pellets placed subcutaneously in order to obtain a more prolonged absorption of the agent. After much trial and error we arrived at our present dose of 100 milligrams by intramuscular injection three times weekly for a period of 8 to 10 weeks making a total dosage of 2400 to 3000 milligrams. We freely admit that we have not come to a final conclusion as to what should be the exact dose, how much total should be delivered and how long it should be continued. Obviously many of these factors must be determined and will be influenced by whether or not the patient

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still menstruates, on whether or not her ovaries have been made functionless by x ray or surgical castration as well as many other factors.

At the present time the work is being pursued by my associates and myself not only in the advanced cases but also in the new cases of early operable breast cancer.

It has now gotten almost beyond the point where it is necessary to demonstrate the value of testosterone therapy by giving case reports as we have already placed ample cases in the literature which show the value. We are now at the point where we can draw general conclusions of what may be anticipated by this therapy.

Our experience has shown that in only a small percentage of cases is improvement to be anticipated when the cancer involves the soft tissues such as liver, lungs, brain and local skin recurrence. It is true that in a few instances there have been striking improvements where an advanced ulcerating breast cancer with surrounding skin nodules axillary nodes and neck nodes were involved where masses were metastatic to the lungs and in one instance where the patient was having convulsions from metastatic disease in the brain. However I fear it must at present be taken for granted that most such cases receive no benefit aside from the temporary general improvement which frequently comes as a result of testosterone injections.

On the other hand a most striking improvement is obtained in most of those cases having bone metastasis. There is some specificity or predilection for the agent to do its work of repair in the bone cases—and as yet we do not understand the reason. It is probable in the metabolism of bone repair under the influence of testosterone that the billions of cancer cells are 'snowed under' by the copious deposit of calcium precipitates especially in areas of bone destruction—a locking in process where cell reproduction is difficult. Similar to prostate cases, the cancer cells will still be present after testosterone therapy. We do not yet know whether the improvement of the bone destruction by the invading cancer is confined to cases of breast cancer alone or whether metastasis to bone from some other

type of cancer may also be improved by testosterone such as from thyroid or ovaries. It is important that this study be pursued and that a study in cases of primary bone sarcoma also be carried out.

After approximately 2 weeks of testosterone therapy the relief of pain from bone metastasis is usually very real. Lack of sleep due to pain is replaced by a natural sleep. It is usually possible to cease giving narcotics which may have been given in large amounts. Some of our patients who had such pain that it was not possible to continue their work, were able to return to their jobs in comfort by the end of a month of therapy. The areas of bone destruction as evidenced by absorption of the calcium salts by collapse of vertebrae, and by fracture of ribs are filled in with dense callus similar to that seen following x ray therapy. How long this improvement in the osseous tissue persists is not yet known. However we have 3 cases in which disease was confined to bone having no ascertainable soft tissue involvement living free of evidence of disease or symptoms for a period of  $1\frac{1}{2}$  to 2 years after commencing the testosterone therapy.

A brief example of one of these cases was a woman aged 71 years who had been confined to her bed for a period of 10 months, with widespread bony metastases to the spine, pelvis and ribs several of the latter being fractured. After 4 weeks of testosterone therapy she was able to leave her bed. At the end of 3 weeks of therapy she developed as is so common the feeling of elation and well being. By the end of 6 weeks she was walking all over the city free from symptoms. The only symptom which bothered her was the annoyance and the irritation of the enlarged clitoris. This patient started on her testosterone therapy in July 1944 and up until December 1, 1946 a period of 2 years 4 months, was living in good health. Three weeks ago she began to have nausea which has persisted, and it may be suspected although not demonstrable that she may have metastases to the liver or to the abdominal lymph nodes. It is not unusual for a patient with metastasis to bone to keep the disease confined there for some time before finally spilling over into soft tissues such as the lungs or abdomen.



Fig. 1. Demonstrating destruction of a large area of frontal bone by metastatic cancer from breast.

In cases of widespread bony metastasis the use of testosterone propionate seems more efficacious longer lasting and more practical than x ray therapy. When it becomes necessary to treat multiple widespread areas of metastatic bone disease, with the x rays it becomes a matter of great difficulty to deliver so many doses over so many areas not only because of the nausea which frequently accompanies such treatments but there is also the practical problem of bringing a patient who suffers intensely from bone metastasis to the hospital or x ray laboratory furthermore such a large number of x ray treatments may produce an anemia in the face of which x ray therapy itself becomes ineffective.

We have had many instances in which the skin of the patient had been so damaged by x ray therapy that it was not possible or practical to deliver further x ray treatments to the bones. Fortunately it is usually possible in such a case to commence with the testosterone therapy and still obtain some degree of clinical improvement.

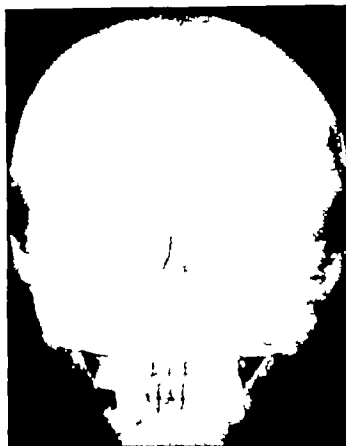


Fig. 2. The same patient 10 weeks later following 24 injections, 100 milligrams each, of testosterone propionate, totaling 2400 milligrams. The area of destruction has been filled in by callus and the mass protruding from the forehead has disappeared.

In the advanced cases of bone metastasis the blood chemistry is fairly consistent. As a rule such a patient has a blood calcium well above the normal of 10 to 12 milligrams per 100 cubic centimeters. The blood calcium at times goes up as high as 17 milligrams. Under testosterone propionate therapy the rule is that the blood calcium slowly comes back into normal limits theoretically being redeposited in the areas of bone destruction.

The alkaline phosphatase also acts characteristically, it is an enzyme necessary for bone repair. The normal limits are 3 to 5 milligrams. During bone repair under testosterone this figure at times reaches as high as 15 milligrams indicating that bone repair is taking place.

Most of our work to date has been on advanced breast cancer cases. However we have recently started to work on the early operable cases of breast cancer using the radical mastectomy supplemented by large doses of testosterone implanted into the latissimus

dorsi muscle or into the subcutaneous tissues near the wound at the time of the operation. Although we have used this combination in 135 such cases to date we have nothing to report as yet. Two months after the operation we will again implant further doses of testosterone on the theory that possibly recurrence and metastasis may be influenced or lessened by subjecting any remaining cancer tissue to the unhealthy environment of testosterone bearing blood and serum. It is obvious that such a human experiment should be under taken and evaluated.

It may be of some interest to note that in two pregnant patients with breast cancer receiving testosterone that repeated Aschheim-Zondek tests were negative up to 5 months of pregnancy when the patients could feel life.

It is scarcely necessary to state that the patient receiving testosterone therapy develops unpleasant masculinizing sequelae as evidenced by a deeper husky voice hair on the

face, pimples on the face and body and an enlarged clitoris which in certain cases becomes a source of great annoyance.

On the other hand under testosterone therapy there is usually at least temporarily a gain in weight, a feeling of well being, a loss of bone pain and a repair of the bone destruction caused by the metastatic disease.

As a rule the *clinical* improvements by the use of testosterone are far more striking than the x ray improvements reveal.

Testosterone may be employed on female patients with breast cancer at any age, while the estrogen therapy must be strictly confined to patients of 60 years and older.

It must be here emphasized that we are not stating that testosterone is a cure for breast cancer however its effects are very profound and gratifying but indicate that much more clinical research must be carried out in this field before we can fully evaluate dosage or final results.

# RESECTION OF INTRA-ABDOMINAL CANCER THAT HAS INVADED THE ANTERIOR ABDOMINAL WALL

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**I**NVASION of the anterior wall by carcinomas primary in the abdominal viscera or invasion of the anterior abdominal wall by metastases from such growths does not constitute a situation in which radical surgical excision is necessarily contraindicated. The primary growth together with its parietal extensions may be excised *en masse* to removal in some instances of all macroscopic evidence of tumor. Such procedures were carried out in a limited group of patients the histories are briefly as follows:

**CASE 1** J. C. no. 283119, male aged 66 years was subjected to a right hemicolectomy. resection of the lower half of the stomach and elliptical portion of the abdominal wall about the umbilicus to remove a large carcinoma of the transverse colon which was spreading to the adjacent structures mentioned. Patient is living and well 4 years and 5 months after operation.

**CASE 2** G. P. no. 332661, male aged 63 years, had a resection *en masse* of 16 centimeters of sigmoid

colon an elliptical segment of the parietal peritoneum and deep fascia in the left lower quadrant and segment of the lower jejunum 10 centimeters in length for carcinoma of the sigmoid which was infiltrating the jejunum and anterior abdominal wall. End-to-end enterostomy and double barrel colostomy were performed and the latter was subsequently closed. Patient is living and well 2 years 5 months after operation.

**CASE 3** Jaw no. 274690, female aged 34 years. Laparotomy was performed for removal of many peritoneal metastases from a pseudomucinous cyst—adenocarcinoma of the right ovary in 1941. A second laparotomy was done for resection of numerous metastases over the peritoneal surfaces of bowels and in the mesentery of the small intestines. A half fist size mass infiltrating the abdominal wall in the right lower quadrant was excised together with portions of the rectus muscle. Patient is living and well 2 years 2 months after second operation.

**CASE 4** J. L. no. 322684, male aged 39 years. Resection of the abdominal wall of the left upper quadrant and subjacent recurrent colon for carcinoma with descending colon spleen containing 4 metastases and tail of pancreas. Double-barrel colostomy was done and was later subsequently closed. Patient is living 1 year 2 months after operation. He has an enlarged nodular liver due to metastases.

**CASE 5** P. W. no. 379472, male aged 38 years. A right hemicolectomy was done and 20 centimeters of

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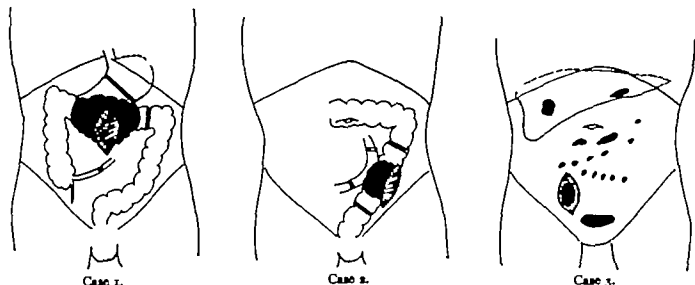


Fig. 1. Diagrammatic representation of operations performed in Cases 1 to 3. Black areas indicate carcinoma.

shaded areas indicate extent of anterior abdominal wall involved by neoplasm and resected.

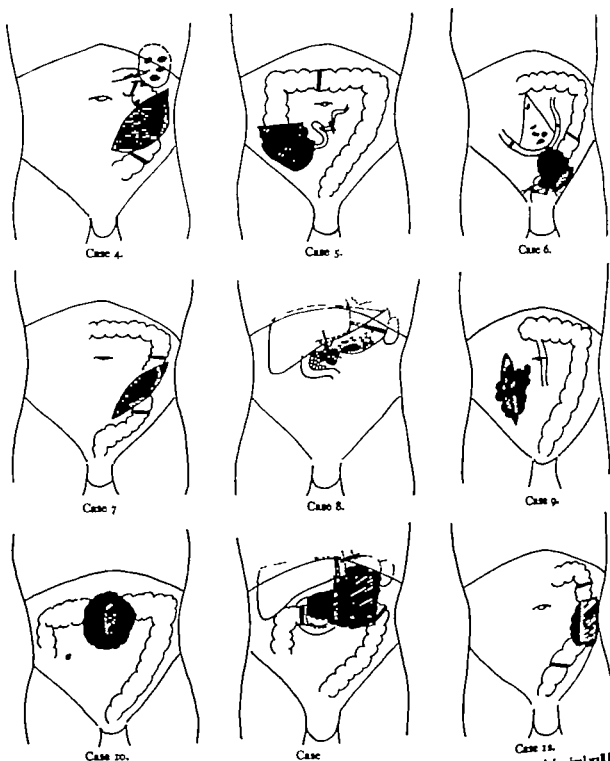


Fig. 2. Diagrammatic representation of operations performed in Cases 4 to 12. Black areas indicate carcinoma,

shaded areas indicate extent of anterior abdominal wall involved by neoplasm and resected.

the lower ileum was resected *en masse* with the abdominal wall of the right lower quadrant for carcinoma primary in the cecum and infiltrating the ab-

dominal wall. Ileo transverse colostomy was made. This patient is living and well 5 months after operation.



Fig 3. Photograph of surgical specimen from Case 5 showing A large segment of lower right quadrant of abdominal wall including skin, subcutaneous fat and musculature infiltrated by C underlying carcinoma arising in cecum, B ascending and transverse colon, I lower ileum.

CASE 6 P. H. L. no 319547 male aged 49 years. An exteriorization excision was done of the sigmoid bearing carcinoma, together with a long loop of the upper ileum invaded by carcinoma, as well as the mesentery of the ileal loop, the dome of the urinary bladder and the deeper portion of the anterior abdominal wall in the left lower quadrant. The colostomy was subsequently closed. Patient lived 14 months returned to work for 8 months, but died of recurrences.

CASE 7 E. R. no 160578 female aged 48 years. An elliptical incision 11 by 7 centimeters was made in the left lower abdominal wall to include the mass of recurrent colon carcinoma (previous Mikulicz resection for primary growth) and the involved subjacent descending colon. A double barrel colostomy was made. Patient lived 10 months then died of recurrences.

CASE 8 C. P. no 325186, female, aged 55 years. Resection was done of the lower two thirds of the stomach, body of pancreas, spleen, periumbilical region of the abdominal wall, the falciform ligament for carcinoma primary in the body of the pancreas, with local spread and metastases to structures mentioned. Patient lived 4 months. She died of carcinomatosis.

CASE 9 E. L. no 350135 female, aged 68 years. Resection *en masse* was done of previous lower right rectus incision scar with underlying mass infiltrating abdominal wall. Multiple small metastatic masses over the peritoneum also were excised. Patient lived 4 months received palliation.

CASE 10 Gomol no 306534 female, aged 52 years. June, 1943 a supracervical hysterectomy and salpingo-oophorectomy for bilateral cyst-adenocarcinoma of ovaries were done. October 1943 the peri-

umbilical region of abdominal wall *en masse* with underlying and attached tumor 15 centimeters in diameter was excised. The latter was a large metastatic mass, the site of extreme pain. Patient survived 2 months. She died of carcinomatosis.

CASE 11 E. B. no 339809 male aged 28 years. Operation was carried out as follows total gastrectomy partial hepatectomy partial pancreatectomy transverse colectomy splenectomy resection *en masse* with the above, of the abdominal wall in the left upper quadrant for round cell sarcoma (radio-resistant). Patient survived 3 months died of rapidly developing sarcomatosis.

CASE 12 C. B. no 255457 male aged 48 years. Resection *en masse* was carried out of cecum ascending colon right kidney and ureter 70 centimeters of ileum and abdominal wall in the right lower quadrant for recurrent carcinoma of the cecum.

TABLE I.—SUMMARY OF RESULTS

Case 1	Living and well	4 yrs. 5 mos.
Case 2	Living and well	2 yrs. 5 mos.
Case 3	Living and well	2 yrs. 2 mos.
Case 4	Living but has hepatic metastases	1 yr. 2 mos.
Case 5	Living and well	5 mos.
Case 6	Lived	1 yr. 2 mos.
Case 7	Lived	10 mos.
Case 8	Lived	4 mos.
Case 9	Lived	4 mos.
Case 10	Lived	3 mos.
Case 11	Lived	3 mos.
Case 12	Lived	12 days
Case 13	Lived	5 days†
Operative Mortality—3 Patients		15-4%

\*Death from coronary occlusion.

†Peritonitis.



Patient died twelfth day postoperative. Necropsy revealed coronary occlusion.

CASE 13 C F no 397424, male, aged 77 years. Exteriorization resection was done of the descending colon and the musculature of the left flank for carcinoma of the former invading abdominal wall musculature with abscess formation

#### DISCUSSION

In all instances it was possible to close the wounds tightly following resection of portions of the abdominal wall. There were no wound disruptions. Soft rubber drains were inserted in some cases when suppuration associated with the parietal invasion was obvious. No definite recommendation may be made for these repairs since each procedure represents a special situation. The generally accepted principles of fashioning full thickness (skin, fascia, and sometimes muscle) sliding flaps are followed.

Three patients have survived over 1 year and are living well, and returned to their usual occupations for an average of 36 months since operation. One patient Case 4 received palliation for a year having returned to his usual occupation but at this writing exhibits deterioration due to obvious multiple hepatic metastases.

The results in the series of 13 patients are summarized in Table I. One patient survived 1 year and 2 months dying of metastases, but had returned to work for a period of 8 months. One is living and apparently well 5 months after operation. The patients who survived for shorter periods appeared to have received palliation although this was brief. Operation was performed in these patients because of pain and obstructive symptoms referable to the mass that was excised together with its parietal extensions. Some of the best results were achieved in patients with cancer of the colon which had invaded the abdominal wall. It has long been recognized that such carcinomas may evolve by local spread to adjacent tissues and viscera before distant metastases occur and these results are in accordance with this principle.

#### SUMMARY

Invasion of the anterior abdominal wall by carcinoma primary in an abdominal viscus does not necessarily indicate that the lesion is inoperable. Palliation and prolonged survival of the patient may follow extensive resections of such neoplasms with their parietal involvements.

# OBSERVATIONS ON THE GENETIC NATURE OF GASTRIC CANCER IN MICE

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THE practice and science of medicine being based exclusively or even predominantly upon the science of bacteriology the conclusion is inevitable to some investigators that a cell or an individual is incapable of doing anything without being impinged upon by some external force. The science of genetics, stemming from the study of embryology teaches differently. Genetics teaches that a zygote that is the fertilized egg when placed in a suitable environment of temperature and humidity, given a few specific chemical entities such as the essential amino acids and the vitamins and a source of energy is capable by development from spatially related internal nuclear entities or genes of giving rise to an adult plant or animal. This determination is so precise that many racial, familial, and individual characteristics are handed down from one generation to the next. This process of heredity has undoubtedly been going on from immemorial time and it probably will go on in the future subject to change only by the sporadic appearance of mutations from time to time. It is the present intention to see whether this concept of biologic determination can also be applied to cancer particularly to cancer of gastric origin.

In the first place all cells of the body are derived by cell division from the zygote. Since cells and tissues reproduce physiological and morphological characteristics of their species in each and every generation they must, of necessity retain many potentialities from their zygotic origin. Superimposed upon this background of intrinsic determinations are many variations necessitated by environmental changes which are not of necessity hereditary. Now cancer is derived by cell division from some somatic tissue and therefore must

retain some potentialities derived from the zygote.

The production of gastric carcinoma in mice was the result of the practical application of genetic principles by which the attempt was made to duplicate or to simulate in mice the variable biological state of the human population. For this purpose the genetic processes of hybridization and selection were used. In addition however each mouse received the subcutaneous injection of 1 milligram of methylcholanthrene dissolved in 0.1 cubic centimeter of sesame oil at 60 days of age. This procedure of injection has been followed for both parents for many generations. Beginning with the early hybrid generations the tendency to give rise to local tumors at the site of the injection of the carcinogen has been suppressed by keeping the descendants of the most resistant to cancer pair of mice in each generation. Due almost exclusively to this regimen of selection toward resistance to induced cancer there has been produced an increased latent period for the appearance of not only locally expected tumors but also of other types of tumors which appeared due no doubt to the fact that the selected hybrid mice with increased biologic variability lived longer than they normally would following the injection of methylcholanthrene. Four stages or classes of mice based upon the classification of induced tumors have appeared in this selection experiment as follows: (1) the appearance of tumors such as epidermoid carcinoma and fibrosarcoma at the site of injection of the carcinogen; (2) the surface spread of tumors over the entire body such as carcinoma of the mouth, the rectum, etc.; (3) the appearance of tumors in the thoracic cavity such as adenocarcinoma of the lung, bronchiogenic carcinoma and mesothelioma; and (4) the occurrence of tumors appearing in the abdomen such as primary carcinoma of the liver, liposarcoma of the uterine mesentery, leiomyosarcoma of the uterus and gastric

This experiment has been made possible by grants from The Jane Coffin Childs Memorial Fund for Medical Research and The Anna Fuller Fund. Presented at the symposium on Cancer before the Clinical Congress of The American College of Surgeons, Cleveland, Ohio, December 16-20, 1946.

carcinoma. Beyond these four stages where specific types of tumors occurred there was obtained a period, of short duration in which no tumors appeared in spite of the fact that an overwhelming dose of a very powerful carcinogen had been injected. Even with continued selection toward greater resistance to all types of induced tumors, there occurred a reversal of susceptibility to induced cancer in which tumors appeared earlier and earlier in the succeeding selected generations. For the present purpose however we shall confine ourselves to the gastric carcinomas which began to appear in stage 4 enumerated above. These gastric lesions showed histological variability some growing as polyps, while others grew invasively through the underlying muscular layers of the stomach. Metastases into the surrounding viscera have also been obtained from these adenocarcinomas of gastric origin. When a suitable genetic experiment had been performed, it was demonstrated that the susceptibility to give rise to this gastric lesion showed linkage relationship with the gene that underlies brown hair pigmentation. Thus it is clear that a mutation has occurred on the brown chromosome sometime during the extent of the injection of methylcholanthrene into mice and that this mutation is responsible in part, for the development of gastric carcinoma following the subcutaneous injection of methylcholanthrene. Another point of genetic interest is the fact that the untreated descendants of these mice which had developed gastric carcinoma following the subcutaneous injection of methylcholanthrene continued to develop gastric carcinoma spontaneously and they have continued to do so through eight untreated generations. At periodic times during the experiment of injecting both parents at sixty days of age with methylcholanthrene a group of 120 mice have been separated off and kept under standard laboratory conditions without being subjected to any experimental procedure. In the succeeding groups of 120 mice referred to above the incidence of spontaneous gastric lesions and carcinomas increased in frequency and, at the same time appeared earlier and earlier in life. Now there is available a strain of mice in which all individuals develop gastric lesions or carcinomas

or some closely related biological entity spontaneously, the males, however showing a greater susceptibility to gastric lesions than do females.

In addition to these gastric lesions of immoal origin there has also been obtained several adenocarcinomas and squamous carcinomas of the forestomach which may serve as a source of material for other types of neoplasia induced by a subcutaneous injection of methylcholanthrene. In the gastric lesion, some of which are undoubtedly adenocarcinomas, it is clear that we have produced a hereditary disease or an inherited susceptibility to a disease by chemical means.

In his very excellent book on the "Foundations of Zoology" Professor W. K. Brooks had this to say "If like Paley I kick a stone I may change its position, raise its temperature, and bring about other changes that might all be computed from a few simple data. What happens if instead of a stone, I kick a dog? What a difference between a kick against a dog and one against a stone! In one case the simple conditions may be stated in a few words, and the result may be computed while in the other, a book would not suffice for the statement of all the facts, and the best science of our day is powerless to compute the result." This illustration is used to discuss the theme of the entire book of the relation of stimulus to intrinsic constitution in biologic response or behavior. Perhaps it is not too far fetched to apply this concept to cellular physiology especially to cancer. One may insult a cell by a multiplicity of agents such as bacteria, viruses, hormones and vitamins, but, in the last analysis, how the cell responds or even acts or fails to respond, is due to no small degree to its intrinsic genetic constitution determined, in part by its origin from the zygote. It is this genetic concept of the nature of intrinsic biologic variability together with chemical induction, that is making possible the development of many benign and malignant tumors in mice. A concept to be of value should not only explain the contributions of the past, but should pave the way for new contributions. It is not out of place to point out to an assembly of surgeons that the cancer problem has not been solved and therefore we should not expect to find the

solution in the literature. Rather should it be desirable to advance in the study of cancer by producing more and more malignant conditions in experimental animals that duplicate or even approach the types of tumors that are killing more and more men and women at an ever increasing rate. For this purpose the genetic concept of cancer has justified itself and

should be of more than an academic interest. In conclusion it may be pointed out that if genetic principles of hybridization, selection and inbreeding are capable of giving rise to a great multiplicity of tumor types then the reverse of these same genetic principles should lead to the building up of a biologic state that will refuse to give rise to cancer in any form.

## CORRELATION OF THE USE OF ANTIBIOTIC AND CHEMOTHERAPEUTIC AGENTS WITH GENERAL PRINCIPLES OF SURGERY

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THE introduction of potent chemotherapeutic and antibiotic agents challenged many traditional concepts in the surgical management of infections. A new group of nonsurgical specialists has arisen from the ranks of internists to concern themselves with the drug treatment of infections previously considered as surgical diseases. Paradoxically this trend has not been correlated with a diminishing surgical responsibility for the treatment of impending or established infections. In fact the net impact of this challenge has been the visualization of new fields for surgical exploitation. Entirely apart from the generally acknowledged necessity for the surgical drainage of pus there are four major problems of clinical concern: (1) treatment of impending wound infection; (2) treatment of mixed infections due to both gram-positive and gram-negative bacteria; (3) treatment of the intravascular complications of bacteremic infections; and (4) rôle of anti-bacterial agents in surgical management.

It is interesting that the dramatic accomplishments of the era of antibacterial therapy have so little altered the integrity of estab-

lished and fundamental principles of surgery. Controversy has attended problems requiring surgical judgment, but control of the capricious quality of bacterial invasiveness has made more clearly evident the violation of fundamental biologic laws. The broad diagnosis of infection can no longer absolve errors in diagnosis, judgment or technique. It is the purpose of this discussion to summarize the basic surgical principles validating this viewpoint.

### TREATMENT OF IMPENDING WOUND INFECTION

Experience in wound management among military surgeons in World War II crystallized much opinion about matters apparently still controversial among civilian and experimental surgeons. The major point at issue is the logic of local chemotherapy. Military experience justifies the abandonment of local chemotherapy in all wounds except occasional complicated wounds of serous cavities or major joints. Included in this philosophy of wound management is abandonment of the concept of prophylactic use of chemotherapeutic and antibiotic agents. Prevention of infection is an exercise in surgical technique. Antibacterial agents are reserved for the treatment of impending infection upon indications derived from clinical appraisal of the wound. Thus, chemotherapy is solely an adjuvant to surgical competency in wound management.

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Wound infection may be subdivided into two major components: invasive infection and wound suppuration. The invasive bacteria, capable of destroying living tissue, are the hemolytic streptococcus, toxigenic clostridium and staphylococcus. All are susceptible to penicillin therapy with occasional strain exceptions. Wound pathogens, responsible for wound suppuration, are a more heterogeneous group and relatively resistant to currently available chemotherapy. In addition the wound pathogens demand a nutritional pabulum other than living tissue within the wound. Devitalized tissue, blood clot and serous exudate in an open wound are removed naturally by septic decomposition; hence, the existence of such a pabulum is of greater clinical importance than the identity of the bacteria concerned with its liquefaction. The initial surgical care of the wound and the use of splints and pressure dressings are far more practical than attempts to sterilize residual dead tissue or exudate within the wound. In other words, the surgically clean wound requires no local chemotherapy and no amount of chemotherapy can sterilize an imperfectly debrided wound.

The living tissues of the wound are best protected from the ever present hazard of invasive infection by perfusion with a blood-borne antibacterial drug. Systemic therapy achieves this objective. It has been learned that the surgically clean soft part wound risks invasive infection only by the hemolytic streptococcus and that sulfonamide therapy adequately anticipates this danger. However, residual blood clot has been found as potentially acceptable as dead muscle as a nidus for clostridium infection. The greater antibacterial potency of penicillin for clostridium and staphylococcus makes it the drug of choice for wounds with residual hematoma or devitalized tissue. Such wounds are the complicated soft part wounds and compound fractures.

Again clinical expediency has dictated the abandonment of routine bacteriologic culture of wounds as an index of infection. The gross pathologic appearance of the wound 3 to 10 days after initial surgical treatment is the best evidence of the adequacy of the initial excision and the presence or absence of infection. It is

this general principle which underlies the two-stage technique of wound management. A further development of importance is the segregation of reparative and reconstructive phases of wound management. Postponement of reconstructive procedures to an elective schedule during convalescence and after wound healing has yielded greater success in ultimate rehabilitation.

#### TREATMENT OF MIXED INFECTIONS DUE TO BOTH GRAM POSITIVE AND GRAM NEGATIVE BACTERIA

Evidence for the minor rôle as wound pathogens of the gram-negative bacilli of the coliform group is gradually appearing. Even in peritonitis and bronchopulmonary suppuration, penicillin appears to be optimally effective when used in dosage adequate to control the gram-positive components of the infection. A similar conclusion has been reached in the study of wound infections.

This reasoning does not extend, however, to infections of the urine, bile or cerebrospinal fluid. These body secretions contain an abundance of essential metabolites for bacterial growth and are deficient in sulfonamide inhibitors. Under the circumstances of mixed infection of the urinary, biliary or cerebrospinal system, the combination of penicillin and either sulfonamide or streptomycin may be desirable. To be effective, chemotherapy must be combined with restoration of normal flow for these systems.

#### TREATMENT OF THE INTRAVASCULAR COMPLICATIONS OF BACTEREMIC INFECTIONS

The reduced mortality rate in bacteremic infections offers the most convincing proof of the potency of presently available antibacterial agents. A consequence of this improved survival rate is an increasing incidence of residual complications of previously infrequent occurrence. Many unusual abscesses, such as the gas abscess of the retroperitoneal space as a complication of gas gangrene of the thigh, have been noted. Such abscesses rarely present problems in diagnosis or management. However, there are certain residual lesions of the vascular bed which are important for recognition and merit discussion as to principles

of treatment. These may be considered in two major categories: first the intravascular foci of suppuration and, second, the metastases therefrom.

The intravascular foci of suppuration may be surgically accessible or surgically inaccessible. That surgical excision of all septic thrombi is not mandatory may be deduced from the experience with endocarditis and cavernous sinus thrombophlebitis. That conservative management is not uniformly successful is apparent from the experience with pyelophlebitis. In the treatment of these lesions it is important to record the gradual abandonment of concomitant anticoagulant therapy in consequence of hemorrhagic complications.

The septic thrombi amenable to surgical attack are those associated with endophlebitis of the peripheral veins. Most frequently involved are the veins of the pelvic, jugular and saphenofemoral systems. The essential pathologic changes of septic endophlebitis render unlikely the detachment of a sufficiently large embolus to produce immediately fatal pulmonary infarction. Most commonly progressive septic infarction of the lung and subsequent focal pneumonitis result. More rarely there is an *extending thrombosis of a major venous pathway*. Such a process in the inferior vena cava with ultimate occlusion of the renal veins is associated with renal shut down and death from uremia. The life endangering qualities of these complications justify surgical intervention for any accessible focus of septic endophlebitis.

The possibility of septic endophlebitis is suggested by recurrent chills, spiking fever and persistent leucocytosis. The early diagnosis of pyogenic thrombosis or septic pulmonary infarction is not always easy. The septic emboli in the lung are usually microabscesses and cast no shadow in the roentgenogram. The characteristic radiologic evidence of multiple rounded areas of lightly increased density is dependent upon the development of pneumonitis around the areas of infarction. It is characteristic of these lesions that as the process of suppuration in the site of infarction advances, the radiologic picture changes. Tense or pneumothorax, pyopneumothorax, empyema and finally necrotic cavities are features of this suppurative

phase demanding appropriate consideration and treatment. Although the ultimate healing of multiple pyogenic abscesses of the lung is remarkably complete in the survivors, early venous interruption is the preferred method of treatment. Local tenderness over a likely venous pathway may be the only clue to the particular site of venous involvement. More rarely, the differential diagnosis of septic endophlebitis and endocarditis of the right side of the heart may require consideration.

Ascending septic thrombophlebitis of the inferior vena cava is usually a complication of an obvious focus of inflammation or abscess of the pelvis or lower extremity. The clue to caval extension of the septic thrombus is massive edema of the extremity at the time of iliac involvement.

As a general principle it may be stated that excision of the affected segment is preferable to proximal ligation. Suppuration of the distal stump such as occurs spontaneously in the veins of the face may demand venotomy for drainage of pus. On the other hand technical considerations dictate simple ligation of the inferior vena cava. This is readily accomplished through a rightsided retroperitoneal approach unless the necessity for concomitant interruption of the ovarian veins dictates a transperitoneal approach.

Another complication and a little emphasized feature of the successful treatment of endocarditis of the left side of the heart is the occurrence of mycotic aneurysms. Early diagnosis of these lesions is mandatory if surgical treatment is to be successful. No method of aneurysmorrhaphy is applicable to the septic and necrotic wall of these aneurysms. The only practical method of treatment is proximal ligation. Fortunately many of these patients are sufficiently youthful so that adequate collateral circulation will develop after such an arterial interruption.

#### ROLE OF A THROMBOTIC AGENT IN THE OVERALL PROGRAM OF CLINICAL MANAGEMENT

The chronically ill patient depleted by persistent infection can rarely be cured by chemotherapy alone. This has been especially emphasized by the experience with actinomycetemia where the recurrent abscesses are not cured by



# PHYSIOLOGIC ASPECTS OF SURGICAL INFECTIONS

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THE direct attack on the bacteria involved in surgical infections has been increasingly effective during the past 10 years. Scarcely a year has elapsed without bringing forth a new chemotherapeutic weapon better for some bacteriological purpose than those hitherto available. However there is ample evidence to indicate that the proper management of infections calls for much more than the ritualistic administration of the right drug for the right organism. It seems appropriate in this symposium to recall attention to three primary reservations which should temper the purely bacteriological approach in the management of surgical infections (1) Chemotherapeutic agents and antiseptics are only useful when they aid rather than interfere with the natural defense and recovery mechanisms of the body in infection the process which Fleming calls 'physiological antiseptics' (2) Effective management of many wounds infested with bacteria requires correction of an unhealthy physiological condition rather than a direct attack on the bacteria (3) In severe infections of almost all types there usually occur profound toxic functional derangements of organs and systems not immediately involved in the infectious process and the chemotherapeutic agents administered will not of themselves serve to remedy the consequences of such disorders.

It is the purpose of this paper briefly to discuss these three aspects of surgical infections and to indicate that the use of our new found weapons against bacteria must be handled with an understanding of their limitations so that we may at all times recognize the ultimate importance of guarding and implementing the physiological mechanisms of recovery from infection whether the infection be in a wound or a systemic invasive infection. The

principles to be discussed are by no means new in fact some of them were clearly recognized long before the discovery of the sulfonamides and penicillin. First will be considered some of the physiological aspects of treatment of localized tissue infections, or infected wounds, and next will be taken up the subject of toxemia in infection.

Sir Alexander Fleming writing of the investigations on wounds during World War I, performed by himself and other members of a research team led by Sir Almroth Wright, made the following significant statement "In view of the observations I have made, and which are quoted above I venture to suggest that the antiseptics at present in use will only exercise a beneficial effect in a septic wound if they possess the property of stimulating or conserving the natural defensive mechanism of the body against infection. If such a thesis be true, then it brings the antiseptic and the physiological treatments on to the same basis and it also makes it necessary in the estimation of the value of an antiseptic, to study its effect on the tissues more than its effect on the bacteria.

The evidence in support of these assertions was largely drawn from a series of laboratory experiments on wounds *in vivo* or on wound exudate *in vitro* with conditions which simulated as closely as possible the actual conditions existing in the wound. It was demonstrated that the ability of bacteria to multiply in wounds is conditioned to a very large extent by (a) the reaction of the exudate loss of alkaline reserve being conducive to bacterial proliferation and (b) the antitryptic capacity of the serum or lymph the presence of a low degree of antitryptic power tending also to encourage bacterial growth. Many bacteria lack the equipment of enzymes necessary to break down complex proteins into assimilable amino acids and peptides and the presence of active proteolytic enzymes in the bacterial environment presumably permits organisms of low

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chronic empyema of pleural decortication under the protection of penicillin demonstrates how a chemotherapeutic agent may aid the surgeon in attaining a physiological objective. In many long-standing leg ulcers the factor of superficial infection contributes to their chronicity, but success in eliminating the hemolytic streptococci staphylococci or colon bacilli will not alone allow the ulcer to heal if the poor circulation in the fibrous ulcer bed cannot sustain the growth and continued vitality of an epithelial covering. Permanent healing may await restoration of normal blood flow in the affected extremity, removal of scar tissue, and application of grafts of healthy skin. There is now ample evidence that chemotherapy and other forms of local treatment of large decubitus ulcers are gestures of futility unless the nutritional debility of the afflicted patient is first corrected and when that has been done and all dead tissue removed plastic closure of the ulcers can be performed successfully in the face of a very considerable amount of bacterial contamination.

The large scale clinical investigation of the use of topical sulfonamide applications in prevention of infection in civilian accidental wounds, which was carried on under the OSRD during the war served to bring out very clearly the primary importance of the physiological condition of the wound and emphasized the limitations of chemotherapy in meeting this problem. Conclusions from this study (3) were recently summarized

"1 Factors tending to delay or interfere with wound repair such as extensive tissue trauma incomplete débridement, or improper or ill advised closure with tension residual dead-space or implantation of foreign materials, will always predispose to the development of infection in accidental wounds.

"2 The use of chemotherapeutic agents in any combination and by any route does not prevent local infection of the wound when these predisposing factors exist.

3 Chemotherapeutic agents are probably of great value in preventing invasive sepsis and death from infection following accidental wounds."

Therefore the surgeon who attempts to lean heavily on the crutch of prophylactic

topical sulfonamides in the performance of reparative surgery will sometimes be disappointed, and many of his good results will have been obtained in spite of rather than because of the application of the drug. However, there appears to be a valuable place for the local use of penicillin, and perhaps streptomycin as well in the treatment of many established infections of wounds, in localized abscesses, acute empyema suppurative arthritis and perostitis meningitis, mastoiditis, and bronchiectasis. This practice is in keeping with physiological management if the antibiotic is also given intramuscularly in full doses to control such invasive aspects of the infection as may be present, and if the topically applied drug is dissolved in a suitable vehicle. The vehicle which has given the best results in cases under my own observation has been normal saline, containing 1000 to 5000 units of penicillin per cubic centimeter administered either by intermittent aspiration and injection as in acute arthritis and empyema or in the case of infected wounds, by intermittent irrigation through a very small indwelling tube which is held in place by the dressing or by loose gauze packing. In order to achieve the maximum effect, the drug must be applied so as to maintain a high concentration continuously in all parts of the wound.

Therefore, to summarize this initial phase of our discussion the primary concern of the surgeon in the care of the localized infectious lesion should be to conserve and augment the natural mechanisms of the body for combating infection. Surgical procedures can be of great value in removing tissues which have lost their capacity to react to infection in improving blood supply, and in providing physiological conditions favorable to healing. Penicillin streptomycin and the sulfonamides will display their greatest value if used with proper discrimination in conjunction with surgery directed toward these ends.

The need for constant attention to the physiological mechanisms of infection is even greater in the management of severe invasive infections, such as peritonitis septicemia, and gas gangrene where their derangement seriously threatens the life of the patient. As one studies these infections at the bedside and in

the experimental laboratory one is increasingly impressed with the similarity between the physiological condition of patients with severe infection and that of patients in shock due to blood loss, to crush syndrome to intestinal obstruction or to severe burns. Much of what has been learned about the prevention and treatment of shock during the last war may properly be applied to the treatment of patients with severe infections.

As used here the term shock connotes an acute maladjustment in the distribution of sufficient available oxygen in the blood to meet the needs of critical organs of the body particularly the liver adrenals, kidneys, and heart muscle. Shock as so defined may be initiated not only by reduction of blood volume below that required for maintenance of circulatory dynamics but also by loss of peripheral vascular tonus by failure of proper oxygenation of the blood and by a pathological alteration in the composition or physical condition of the blood.

Penttonitis perhaps illustrates the various aspects of shock in infection better than any other surgical infection because it brings into simultaneous interplay a number of factors which contribute to development of shock as it has been here defined. During the past 2 years I have had the opportunity of studying this subject extensively in dogs in the experimental laboratory in collaboration with Doctors John H. Kay and Donald G. C. Clark (3, 9, 10). During the critical period of the disease salt and water are lost externally in vomitus, or in decompression of the paralyzed bowel and internally into the edematous peritoneum and intestinal wall. Plasma protein is taken out of circulation in the process of formation of peritoneal exudate. Many red cells are destroyed by hemolysis and others are lost from effective use as oxygen conductors by stagnation in the engorged vessels of the peritoneum and by the formation of sticky conglutinated masses of what Knusely has aptly called sludge. All of these factors unless corrected, contribute to the development of a progressively falling blood volume. However replacement of the lost volume of blood does not necessarily relieve the shock state in peritonitis, a fact which was demon-

strated during the war by Emerson and Ebert. One reasonable explanation of this is that the lysis of Gram negative bacteria present in the exudates of peritonitis permits the liberation of endotoxins into the portal and systemic circulations, which specifically impair the functions of capillaries and of cell membranes not only in the liver to which these toxins are presumably carried in their most concentrated form but in other essential organs as well (15). Therefore, the shock state in peritonitis is probably compounded of reduced blood volume, plus the direct toxic action of products of bacterial and tissue origin. An interesting practical sidelight on the activity of endotoxins of Gram negative bacilli is the evidence now available from several sources (16) that the sulfonamides exercise a nonspecific protective action in animals against the lethal effects of such toxins. The beneficial use of sulfonamide prophylaxis and treatment of peritonitis may be attributable as much to this antitoxic action as to the repression of bacterial growth in the peritoneal cavity. We should therefore not be hasty to abandon entirely the use of sulfonamides in peritonitis in favor of the newer antibiotic agents, such as penicillin and streptomycin until opportunity has been afforded to study more fully the comparative usefulness of these agents in combating the factor of toxemia.

Still another physiological system which appears to be thrown out of balance in peritonitis is the equilibrium between the plasma proteolytic enzyme and its respective inhibitor. This is essentially the same system which Fleming was concerned with in his study of wound exudates, to which reference was made in the first portion of this paper. The proteolytic enzyme which is normally available for activation in plasma and which is most readily demonstrated through its lytic action on fibrinogen and fibrin, presumably exists for the most part in the form of an inactive precursor. However just as is the case with pancreatic trypsin which it resembles, the plasma protease may become converted to its active form through contact with activators of bacterial and tissue origin. The so called fibrinolysin of the hemolytic streptococcus is, in fact merely an activator of the

plasma proteolytic enzyme system and in conformity with conventional terminology, has been renamed 'streptokinase' (12). The action of the plasma protease is normally counterbalanced by a circulating inhibitor factor corresponding to and closely resembling the pancreatic trypsin inhibitor. However it was found (10) that in the crisis of peritonitis in the dog this equilibrium is thrown out of balance and the 'escape' of the lytic principle is evidenced by an increase in the lytic activity of plasma against both fibrinogen and fibrin. Lysis of circulating fibrinogen and perhaps of prothrombin as well appears to explain why the blood of animals and patients in shock from peritonitis and from other causes sometimes fails to clot. The work of Grob suggested a method of determining the significance of increased plasma proteolytic activity in the pathogenesis of peritonitis. He had shown that increasing the titer of protease inhibitor by repeated intramuscular injections or oral feeding of trypsin is accompanied by a marked increase in the ability of animals to withstand the local digestion of tissues caused by subcutaneous injection of proteolytic enzymes of animal and bacterial origin. My colleagues and I therefore undertook to evaluate the protective influence of repeated trypsin injections against the lethal sequences of appendiceal peritonitis, and obtained an interesting result. Peritonitis was produced in 18 pairs of dogs by appendiceal ligation; one of each pair had received daily intramuscular injections of crystalline trypsin for 12 days and the other was a control. The management of the animals was in all respects identical and the healthier looking dog of each pair was always selected to be the control. The end result was the survival of 15 trypsin prepared animals and of only 6 controls. The animals which had received trypsin preparation failed to display many of the morbid clinical and laboratory signs which were conspicuous in the controls. It may be added that efforts to influence the morbidity and mortality of the experimental disease in dogs were far less successful when chemotherapeutic agents were employed. The mortality rate in 15 dogs treated with large doses of penicillin was 33 1/3 per cent (10). These experimental studies are

mentioned here in order to indicate that there are important aspects in the morbid process of an established infection which are not likely to be countered solely by the administration of bacteriostatic chemotherapeutic drugs. We must continue to recognize that the infected patient is a more complicated system than a laboratory culture and that recovery from infections requires the stabilization or readjustment of many physiological disturbances which the infection has created.

Therefore in treating the toxemia of severe infection, all possible use should be made of penicillin, sulfonamides, and streptomycin but the fundamental physiological disorders that derive from bacterial infection must also be kept in mind, so that adequate supportive treatment, as well as chemotherapy may be given. The following aspects of supportive treatment deserve particular emphasis.

1. Patients with serious invasive infections including peritonitis, bacteremias of all types, gas gangrene, and meningitis should be handled with the same concern for maintenance of blood volume as is employed in modern treatment of severe burns, and of hemorrhagic or postoperative shock. This will require generous use of whole blood, of plasma, and of saline and glucose solutions, guided by frequent estimations of hematocrit, serum proteins and electrolytes and urinary output.

2. These patients should not be permitted to suffer from even temporary protein starvation. The patient with an acute infection is undergoing very active protein catabolism; the quantity of nitrogen excreted in the urine reflects a utilization of protein which is equivalent to three or four times the normal daily requirement. Still more is being continuously lost in the formation of inflammatory exudates. For example a patient with empyema may be losing the equivalent of a pint of plasma each day in the form of purulent thoracentesis fluid. Unless an equivalent amount of protein is supplied in the diet or by parenteral injections, a rapid depletion of liver and muscle protein is bound to occur thereby undermining the resistance of the patient and aggravating the problem of his convalescence. All patients with infections should be maintained on a high protein, high caloric intake and a

record should be kept of the amounts of food actually ingested. If oral feeding is contraindicated protein should be given parenterally by a suitable hydrolysate, with glucose. The average adult patient should receive at least 125 grams of protein and 2500 calories, daily.

3 The utilization and excretion of several of the vitamins is much increased during acute and chronic infections. After studying the requirements of patients in shock from various causes Levenson and his associates have recommended the following daily doses of vitamins during the period of acute stress

Ascorbic acid	.50 gram
Thiamin	50 mgm.
Riboflavin	50 mgm.
Nicotinic acid	500 mgm.

After the period of critical illness has passed these doses may be reduced to approximately one fifth of the above figures.

In view of the possibility that some of the physiological derangements in severe infections are related to inadequate storage of these vitamins, this aspect of balanced supportive treatment should not be neglected.

4. Since the absorption of toxic breakdown products of bacteria and tissue is still the basis of toxemia in infection much caution should be exercised before abandoning to chemotherapy exclusively the treatment of conditions in which surgical intervention has been our principal life-saving weapon in the past. The evidence may now justify the nonoperative treatment (1) of acute hematogenous osteomyelitis and other invasive infections where the susceptibility of the causative bacteria to penicillin may in most cases be assumed, but it is doubtful that chemotherapy will ever be more than a valued adjunct to surgery in the treatment of conditions such as appendicitis and its complications, and chronic pulmonary suppuration and gas gangrene. Penicillin in large doses may be of definite value in established peritonitis following neglected appendicitis, as the recent report of Crile has shown but it will not compete with surgery as the principal treatment of choice in acute appendicitis.

#### SUMMARY AND CONCLUSIONS

1 Chemotherapeutic agents should be selected, and used, with a view toward aiding in the natural resistance of the body to infection.

2 Although it is important, wherever possible, to employ treatment directed specifically against the bacteria involved in an infection, the treatment of associated disorders should not be neglected. In certain conditions the persistence of the infection is entirely dependent on an underlying physiological lesion, and in these cases, chemotherapy is of only secondary importance.

3 Rational treatment of severe infection characterized by toxemia demands supportive measures as well as administration of chemotherapeutic agents. Particular attention must be given to maintenance of blood volume, provision of an adequate intake of protein, calories and vitamins, and surgical removal of the cause of the toxemia.

4. Study of the pathologic physiology of the toxemia of infections should be encouraged, in the hope that mortality from these conditions may be still further reduced.

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# SYMPATHETIC INTERRUPTION IN CASES OF TRAUMA AND IN POSTTRAUMATIC STATES

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THERE can be no doubt that an erroneous impression has persisted from the past concerning the favorable influence of war upon medical progress. Actually the period of war must be recognized as having resulted in retardation of progress as compared with what might have come from a period of peace whether measured by the health and longevity of the world population the adequacy of undergraduate and graduate training of physicians or the advancement of fundamental and applied knowledge. It behooves us then to salvage from the war effort all accomplishments which may be useful in the conduct of any future military engagement and more particularly those contributions which may aid in peacetime practice.

In the recent conflict not only was military medicine on a higher plane than in any preceding war but circumstances permitted a better evaluation of the preventive diagnostic and therapeutic means which were utilized. Of especial importance in this regard was the creation by the Surgeon General of special centers for the care of certain types of injuries and disease, a plan which made possible careful study of these disorders and of their treatment under favorable circumstances by a group of medical officers competent for this task by special interest and professional preparation. Their study was however necessarily limited more or less to the later manifestations of these conditions, although prompt evacuation sometimes placed in their hands patients ill or disabled for only a few weeks. In addition, in spite of the difficulties resulting from the necessity for prompt evacuation of patients certain deficiencies in facilities and other cir-

cumstances arising from military demands a considerable number of very informative reports have come from the Forward Areas. Such contributions naturally are attributable primarily to the proficiency and scientific interest of those who conducted them. Great credit must be given however, to the Surgeon General's Office and to the consultant system utilized in the various theaters of command and to their earnest, if not always successful efforts to assign duties to medical officers according to their training and ability, to support them whenever possible with adequate equipment and to stimulate the careful recording of case records.

The segregation of patients with vascular disorders and abnormalities involving sympathetic function in the Vascular and Neurosurgical Centers permitted a study of many of the problems for which sympathetic interruption has been recommended as beneficial in numbers rarely if ever before approached. This information has been supplemented by observations of these and allied conditions in Forward Areas. It is the purpose of this communication to inquire into the rôle of temporary and permanent interruption of the sympathetic nerves in the care of patients who have sustained trauma. No detailed analysis will be attempted but rather a general presentation of the problem as it developed in my own experience and as it has been presented by other medical officers in the current American literature. For the sake of brevity I shall omit reference to the valuable work of numerous investigators whose contributions before the war established the principles and fundamental background for the application of sympathetic interruption in the surgery of warfare. One cannot emphasize too strongly the value of these investigations. Certain personal observations from the recent war have already been recorded in more detail elsewhere by my associates and me (26-29) and other reports

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covering sympathetic interruption in such conditions as the post traumatic vasomotor disorders, cases of injury to major arteries, caualgia, and frostbite will be reported subsequently. The problems under consideration will be discussed primarily from the standpoint of the efficacy and the limitations of these procedures in therapy whereas consideration of the often poorly understood underlying physiopathological mechanisms by which the sympathetic nervous system is involved as a component in these various states will be omitted.

In an effort to clarify the matter the various traumatic conditions will be presented under several headings although it is realized that in any given patient the condition may not be a pure one fitting precisely into any one of these categories but may have features common to several of them.

#### ARTERIAL STUPOR OR SEGMENTAL ARTERIAL SPASM

It has long been recognized that trauma which actually inflicts no direct injury to an artery may initiate a reflex spasm of such degree that blood flow through this vessel may be interrupted with resultant gangrene or ischemic paralysis in certain instances. Specific directives were issued giving proper instructions for the management of this condition. No large group of such cases is available for study. Presumably they were handled in the following manner by periarterial sympathectomy when the artery was exposed in the course of débridement, and in all instances by prompt and repeated use of sympathetic blocks and other efforts to release vasoconstriction until permanent restoration of normal blood flow had been achieved. It is likely that a significant number of cases of segmental arterial spasm involving major arterial stems must have occurred among the thousands of cases of trauma to extremities. The best index of the efficacy of treatment is the fact that only a few instances of ischemic difficulties arising from this condition were seen in the Vascular Centers into which were funneled most of the patients with vascular injuries. These exceptional cases—tragic examples of loss of limb and of function without

direct arterial injury—likewise serve as a stern warning for the necessity of prompt and proper treatment.

From the war experience it would appear that the following points are important in the management of this condition. Physicians must be aware of its existence and trained in its recognition. It must be considered a possibility in any case of injury in which the peripheral pulses in the limb have disappeared with resultant evidence of ischemia, and particularly when there is no significant external bleeding or hematoma and no sign of an arteriovenous shunt. It is important that operators be trained to recognize the spastic artery and differentiate it from other conditions following trauma, such as compression by hematoma or intra-arterial thrombosis. In general, the artery will be found to be pale and narrowed in caliber with good pulsation above the area of constriction and with weak or absent pulsation below. Generally there will be no hemorrhage in the artery wall. There will be no firm intra-arterial mass or distention of the lumen, conditions which are commonly observed in embolism or thrombosis.

Once the condition has been diagnosed or is suspected every effort should be made to release vasoconstriction. If the artery is exposed at operation its outer wall should be infiltrated with procaine and it should be carefully stripped of its adventitia. Warming of the body but not of the involved limb should be carried out. A sympathetic block or a spinal anesthesia should be done promptly. If vasodilatation and return of pulsations follow the block or spinal anesthesia but last for only a short while sympathetic blocks should be repeated at frequent intervals. Should the benefit following each block be of short duration, one should not hesitate to proceed with operative sympathectomy or with alcohol block if the patient's condition makes operation ill-advised. The limb itself should be protected from trauma and infection and should be left exposed to room temperature. Local warmth should never be applied unless there is conclusive evidence that one is dealing purely with a remedial condition of arterial spasm without any organic interruption of the continuity

of blood flow. If sustained return of normal blood flow is difficult to achieve promptly and there is no associated injury or disease contraindicating such treatment, anticoagulant therapy should be instituted without delay in order to inhibit thrombosis in the affected artery and in its collaterals.

No data are available as to the incidence of failures in patients who have been treated promptly and adequately. It may be anticipated that success will accompany such a program of treatment.

#### TRAUMATIC INJURY OF MAJOR ARTERIES

Though they did not constitute a considerable proportion of battle casualties, cases of direct trauma to major arteries presented a difficult therapeutic problem. Odom reported that there were 837 vascular injuries to major arteries among the 92,030 battle casualties sustained by the Third Army during a 9 month campaign in Europe, an incidence of 0.9 per cent. Four hundred and twenty three of the 1833 amputations performed were necessitated by injuries to blood vessels (23 per cent). De Bakey and Simone stated that 0.96 per cent of 163,980 battle casualties were wounds of arteries and 618 of the 3177 amputations from the Mediterranean and European Theaters were carried out because of arterial injury (19.5 per cent). In a smaller series of cases, Kirtley found that 20 per cent of major amputations were done because of inadequate blood supply. Bradford and Moore reported that 0.7 per cent of 16,000 surgical admissions to their hospital had injuries of important arteries. It may be concluded that slightly less than 1 of each 100 soldiers wounded in combat sustained an arterial injury and that approximately 20 per cent of all major amputations were performed because of trauma to blood vessels.

Medical officers were instructed by directive to utilize sympathetic blocks in all injuries of major arteries in which the circulation was definitely or questionably jeopardized. The results of this procedure for obvious reasons, are difficult to analyze. The additional therapy in cases of arterial injury was never dependably identical. In some the concomitant vein was ligated while in others it was left intact.

Although ligation and division of the artery were recommended in certain cases ligation in continuity was performed. In some, an effort to maintain the continuity of the blood flow by suture or nonsuture methods was attempted while in the majority no such efforts were made. In most instances adequate control of any attendant shock was promptly accomplished but not in all. There was not uniformity in the application of measures to prevent infection and additional trauma nor in regard to the temperature to which the limb was exposed. Indeed, adequate sympathetic anesthesia was undoubtedly not always obtained by efforts to block the chain. Of equal import is the fact that sympathetic blocks were carried out as often as necessary in some cases and too few blocks spaced over too wide intervals in others. Of perhaps even greater importance in making evaluation of this procedure difficult is the varying character of the injury incurred.

In order to arrive at valid statistical conclusions one would not only have to segregate treated and untreated cases according to the location of the arterial injury but would have to be certain that the two groups were comparable from the standpoint of the character of the local lesion, the associated trauma and the general state of circulation. Actually the extent of local trauma varied. In certain patients the artery was thrombosed without laceration in others simply lacerated or severed in still others badly damaged over a considerable extent. Sometimes there was extensive local trauma with injury to collateral vessels, extravasation and edema, as well as associated fractures of varying severity or injuries to peripheral nerves. In contrast some patients had no associated lesion of any significant extent. Furthermore in spite of efforts to the contrary case records of patients were often deficient with regard to important factors concerning the character and the extent of the local and general injury and in regard to the therapeutic means employed. It must be remembered too that analysis of the results of sympathetic interruption solely on a basis of the incidence of gangrene necessitating major amputation as is sometimes done omits consideration of possible effects of this treatment upon subsequent





the exercise tolerance was not strikingly altered

The results of sympathetic interruption in cases in which blood flow through a major artery was interrupted by trauma indicated this procedure to be of definite benefit, in my opinion at the same time they clearly demonstrated that this procedure offered no guarantee against ischemic difficulties. With regard to civilian practice I believe the military experience would suggest that every lacerated artery be repaired if this were possible that sympathetic blocks be used promptly and as often as necessary, that when improvement with blocks is only transient permanent sympathectomy be performed by operation if feasible otherwise by alcohol injection. If sympathectomy is not carried out all additional aids in vasodilatation should be utilized such as reflex vasodilatation and the oral administration of alcohol. The limb is to be left exposed to room temperature and to be protected from injury and infection.

It is my impression that early sympathectomy will often prove helpful when procaine blocks are of little permanent help due to their transient benefit. In selected cases seen later after injury sympathetic blocks and more often sympathectomy will be found to be of considerable aid.

#### ARTERIAL ANEURYSMS AND ARTERIOVENOUS FISTULAS

Before the war sympathectomy or alcoholic infiltration of the sympathetic nerves had been used sufficiently often in cases of aneurysm and arteriovenous fistula to establish its usefulness as an adjuvant in their operative treatment. A number of surgeons during the war had occasion to employ sympathetic blocks or sympathectomy in such cases and held the opinion that they were useful aids. In the three Vascular Centers sympathectomy and sympathetic blocks were utilized in varying degrees. In general, these procedures were not employed at the Ashford General Hospital, and the brilliant results obtained there by Elkin and his associates furnish striking proof that large numbers of patients can be treated successfully without resorting to sympathetic interruption, though those of us who

have studied patients after sympathectomy have been convinced of its usefulness. At the De Witt General Hospital sympathetic interruption was used fairly extensively and was thought to be very helpful in selected cases (11). At the Mayo General Hospital a great many sympathectomies were performed. This experience has permitted me to evaluate the procedure carefully and to formulate certain concepts concerning its benefits and its limitations.

Sympathectomy tends to render the collateral circulation more efficient by elimination of vasoconstriction in the collateral vessels. Though sympathectomy may also contribute to improvement in circulation by fostering growth of new collaterals and though certain observations suggest that this may be true, convincing proof has not been demonstrated. When the collateral circulation appears insufficient according to carefully performed tests when a sufficient time has elapsed to have ordinarily brought about adequate collateral circulation and when such means as intermittent occlusion of the artery appear to be achieving little or no improvement, sympathectomy is indicated. It is also indicated in all cases with poor collateral circulation in which intense pain, infection or threat of rupture make the necessity for early operation a real possibility. In the majority of cases the collateral circulation will be found to be adequate immediately or shortly after sympathectomy. In a number however the tests for collateral circulation may show improvement but may not become adequate over a period of months. Because sympathectomy has been accomplished one can in no sense assume that the collateral circulation will be invariably satisfactory or that gangrene or ischemic paralysis will always be prevented.

Sympathectomy is indicated in any case in which an aneurysm or fistula is associated with a peripheral nerve lesion and in which the collateral circulation is precarious indeed in any case with severe peripheral nerve injury and obviously impaired circulation regardless of whether tests for collateral circulation are satisfactory or not. It appears wise to do everything in these cases to make possible

early surgical treatment of the aneurysm or fistula in order to avoid delay in operating upon the damaged nerves. Occasionally one will find it advisable to perform sympathectomy as a safeguard in cases of vascular lesions of important main stem arteries when the location of the lesion makes accurate compression of the artery and testing of the collateral circulation impossible. It appears rational to perform sympathectomy in those cases with ischemic lesions distal to an aneurysm or fistula. It is indicated when there is significant vasospasm in the affected extremity. The procedure may occasionally be advisable when one or more of the important arteries in a limb have already been ligated or thrombosed and in which cure of aneurysm may entail ligation of other important arteries or collaterals. Sympathectomy may sometimes be required because of associated causalgia.

Sympathectomy need not necessarily be performed before operation; the two procedures can often be carried out in one session. In every instance however one should retest the collateral circulation after sympathectomy and make certain that it is satisfactory before proceeding with the surgical treatment of the aneurysm or fistula.

After operation, sympathectomy will also be found to be an adjuvant in correcting certain difficulties which sometimes follow extirpation of an aneurysm or fistula. It is clearly indicated when there is annoying or incapacitating sensitivity of the hand or foot to cold in a patient whose place of residence and work or avocation make such exposure necessary and when improvement in symptoms is noted on exposure to cold during a period of procaine sympathetic anesthesia. It is useful in cases of persistent edema which have not improved upon conservative treatment. It is generally helpful and often dramatically so in cases of ischemic paralysis. It appears to foster return of nerve function in cases of peripheral nerve injury in which the circulation is impaired. It is also useful in the treatment of associated causalgia which is improved temporarily but not cured by sympathetic blocks. When a limb is found to be cold and pale or cyanotic after operation or

when gangrene is definitely threatened, sympathectomy should be utilized in some cases; it brings about gratifying restoration of good circulation though it will not always prevent gangrene. In regard to the two commonest circulatory disorders which may follow sympathectomy—sensitivity of the limb to cold and decrease in exercise tolerance, the procedure has a very beneficial effect upon the former but rarely has a striking effect upon the latter.

It is my feeling that when sympathetic interruption appears to be indicated, permanent sympathectomy is generally preferable to procaine blocks, though blocks undoubtedly have a place in the treatment of certain cases. Sympathetic interruption seems justified for the indications which have been enumerated where no clear indication exists; there seems to be no point in performing the procedure. It must be looked upon as a valuable adjuvant in the surgical treatment of aneurysms and fistulas. It cannot be relied upon as a certain guarantee against ischemic difficulties, nor can it be relied upon as a sure corrective for all functional disorders which may be present.

To have performed a sympathectomy does not relieve the surgeon of responsibility for utilizing carefully performed tests for collateral circulation for exercising every care to prevent destruction of collateral vessels at the time of operation and for preserving the continuity of the artery if possible.

#### THE POSTTRAUMATIC DISORDERS

The posttraumatic vasomotor disorders comprise a number of conditions about which many divergent opinions are held. Some would include only those cases with edema, pain, weakness, disability, atrophy, osteoporosis, and either vasoconstriction or vasodilatation. Others would include in this category various vasomotor disturbances following trauma, infection and such vascular disorders as thrombophlebitis. The discussion here will be limited to the difficulties following trauma or to trauma and associated infection. It has been my experience that these disorders may be characterized by various complaints and physical findings. In some

pain is present either at rest or more commonly with activity and weight bearing in others pain is absent. In some edema is massive, in others moderate or mild, and some have no edema at all. Some have evidence of vasodilatation the majority of vasoconstriction. Cyanosis, coldness, sensitivity of the part to cold and hyperhidrosis may be present in varying degree. Some have marked weakness of muscles, some virtual paralysis. Sensory changes may be present.

In a group of disorders so varied in their manifestations there is little wonder that treatment cannot be stereotyped and that results of therapy are not uniform. Those who have utilized sympathetic blocks and sympathectomy have been favorably impressed with the results of such treatment (32) as have my associates and I. It is not my feeling that such treatment should invariably be applied or that it can ever be utilized as the sole means of therapy. It is difficult to outline concisely one's views of treatment for such a complex problem but to do so as succinctly as possible the following suggestions are made.

In any case of trauma which is unassociated with injuries contraindicating such treatment early active use of the part should be instituted. Obviously wounds must be debrided, fractures properly reduced and immobilized and every precaution taken to prevent infection. Whenever edema is present proper elastic support, elevation and gradual increasing use of the limb in dependency should be utilized. One must be sure to encourage the patient and to do everything to prevent development of an attitude of invalidism. If a real neuropsychiatric factor exists, it must be recognized and suitable treatment instituted.

Whenever there are signs or symptoms suggesting a reflex disturbance such as is under consideration and these manifestations prevent active use of the limb or do not improve rapidly with such activity and with proper associated treatment, sympathetic blocks should be tried without delay and should be repeated as frequently and as often as necessary. If they bring about transient improvement but appear to have no permanent

benefit, one should not hesitate to proceed with sympathectomy. In certain cases it will be preferable to employ local procaine infiltration first before performing sympathetic blocks. If such local infiltration brings about temporary benefit but no cumulative improvement and an irritable trigger zone seems to exist which can feasibly be excised such a procedure may be indicated. In connection with local infiltration it is proper to introduce here the technique of procainization in the early treatment of sprains and strains which was found very effective in army personnel (20). That at least part of this benefit results from blocking the sympathetic impulses is suggested by the fact that such injuries have been treated with equal success by sympathetic blocks (32).

In the treatment of the late sequelae we have found that many patients obtain an excellent result from active use of the limb, physiotherapy and elastic support when needed. It was found that in a small number of patients manifestations very similar to those generally observed were either initiated or perpetuated by neuropsychiatric factors. In such cases psychiatric therapy is obviously required. In some a brilliant result is quickly achieved, others are very refractory. In rare cases responding unsatisfactorily to psychiatric treatment, sympathetic interruption may be a useful adjuvant in correcting certain manifestations such as persistent massive edema. When the simpler means of treatment show no promise sympathetic blocks should be carried out. Occasionally a patient is helped decidedly by blocks but ordinarily any beneficial effect is transitory. In general sympathectomy is the procedure of choice for such cases. Except for cases in which a fundamental psychiatric problem has been unrecognized before operation, the results are gratifying. The manifestations of vasospasm and sympathetic overactivity respond dramatically: cyanosis, coldness, hyperhidrosis are relieved and sensitivity to cold is cured or improved. Edema is generally lessened sometimes dramatically. Pain is generally improved and is sometimes completely eliminated. Sympathetic interruption can never be regarded however as the sole

*form of treatment.* Whether it is used or not, the patient must be encouraged active exercise must be enforced and edema must be dealt with by elastic support, rest, and gradually increasing dependency.

No data have been made available in regard to possible usefulness of sympathetic interruption in the healing of fractures. It has been demonstrated however that sympathectomy may be extremely useful in reducing edema and in eliminating marked vasospasm before bone grafting and other plastic restorative procedures.

#### CAUSALGIA

The war afforded an unparalleled opportunity for studying large numbers of cases of causalgia and their treatment (2 12 18 24, 31 33). In general excellent results from sympathectomy were obtained. The majority of patients obtained complete relief and improvement was almost invariably noted in the remainder. It has been the common observation that the results were better in the upper extremity than in the lower. Certain observations suggest that the poorer results in the lower extremity may be due in part to incompleteness of the ganglionectomy—that it may be necessary to sympathectomize completely the area of the nerve lesion as well as that to which the pain is referred (2 33). The series of Rasmussen and Friedman suggests that postganglionic operations for the upper extremity are inferior to the commonly employed preganglionic operation in the treatment of causalgia. Although such observations have not been uniformly made it has been my experience that the more severe the pain the more apt one is to obtain complete relief following sympathectomy. Since the pain is generally more severe in the upper extremities this may be an additional factor in the somewhat higher incidence of complete cures in these cases as contrasted with those having involvement of the lower extremities. In general it is thought that the results are more favorable the earlier treatment is instituted.

Some surgeons have utilized sympathetic blocks only as diagnostic and prognostic tests and some (33) have never obtained permanent

relief from any number of procaine sympathetic blocks. Though we found that sympathectomy was necessary in the majority of cases, my associates and I observed permanent relief from sympathetic blocks in numerous instances. It is our feeling that one should proceed with sympathectomy if relief of pain is limited to the period of sympathetic block and that a series of blocks should be tried in patients who experience prolonged relief after a procaine block. If the relief does not become progressively more prolonged as additional blocks are carried out, they should be abandoned and operation should be carried out. It is apparent from the experience in the war that a rare patient with causalgia may be cured by neurolysis or neurothraphy or by artificial fever therapy. A rare case, too, may be associated with definite neuropsychiatric features and respond favorably to psychiatric therapy (16). In general, however sympathectomy is required. Altogether the results are brilliant.

#### PHANTOM LIMB PAIN AND AMPUTATION STUMP PAIN

Few wartime observations have come to my attention concerning the use of sympathetic interruption in the distressing phantom limb syndrome and in amputation stump pain. To be sure, a few cases of pain and vasospasm in minor amputation stumps with improvement or relief following sympathectomy have been recorded (12) and I have made similar observations. In addition, Pool has used sympathectomy in conjunction with cordotomy in a few cases of phantom limb pain and has the impression that sympathectomy may be helpful in relieving the burning pain seen in this syndrome. In general, however no studies have been made of sympathetic interruption in the complex amputation stump pain following major amputations nor in the phantom limb syndrome—in all likelihood a reflection of the infrequency with which these difficulties have occurred in military personnel. I believe the primary lesson to be learned from the experience in the recent war deals not with the treatment of amputation stump pain and phantom limb pain but with their prevention by proper operative technique, by early active

use of the stump and by careful conditioning of amputees to the normal physiological sensations of a phantom limb which they almost invariably experience (19). I have had occasion to observe in patients in whom such procedures were performed for other reasons that the normal phantom limb sensations may be temporarily but not permanently relieved both by sympathetic blocks and by sympathectomy. My own small experience would lead me to believe that sympathectomy rarely has a place in the treatment of amputation stump and phantom limb pain.

#### THE INJURIES DUE TO COLD

Opinions are at wide variance in regard to the rôle of sympathetic interruption in the injuries due to cold—frostbite, trench foot, and immersion foot or hand. Elsewhere (28) I have attempted to review this subject. It appears clear that although other factors may have a part, thrombosis of arteries and arterioles is the primary factor concerned in the production of gangrene—the most disastrous sequel to injuries from cold. It is further well established that vasoconstriction is the primary response of the body to exposure to cold, and that, although a transient period of reactive hyperemia may follow vasoconstriction is one of the commonest sequela. These facts would suggest that efforts to block sympathetic impulses and combat vasospasm might be fruitful in the treatment of the acute and later manifestations of these disorders.

Numerous students have advised against sympathetic interruption in the early stages of trench foot, immersion foot, and frostbite, perhaps on insecure grounds. There is little information from our own war experiences concerning the effect of these procedures in the early treatment of frostbite although some of our allies and opponents reported good results with sympathetic blocks and periarterial sympathectomy. Davis and associates, who felt that it was important to release vasoconstriction as rapidly as possible, found that direct blocking of the sympathetic pathways was the only means of accomplishing this end in severe high altitude frostbite. Southworth has treated a few cases of early frostbite by sympathetic blocks with apparent

benefit. Berson and Angelucci noted no improvement with sympathetic blocks in a few early cases of trench foot with massive edema, but obtained temporary diminution of pain and tenderness in milder cases. Leigh reported that sympathetic blocks were of no aid in the early treatment of trench foot. Edwards and his co-workers in a small group of cases, found that sympathectomy gave good results in the early treatment of trench foot with gangrene but that it was not helpful in cases with tender painful and aching feet. No studies have come to my attention concerning the use of sympathetic interruption in the treatment of the acute phases of the immersion injuries.

With regard to treatment of late manifestations of these disorders, the rôle of sympathetic interruption has been more clearly defined. The results of sympathectomy are good in properly selected cases of frostbite. The procedure is useful in cases of gangrene, excessive hyperhidrosis, persistent marked vasospasm, sensitivity of the hand or foot to cold and sensory changes. Southworth reported some observations suggesting that repeated procaine blocks, alcohol blocks, or sympathectomy may be helpful. Berson and Angelucci reported that sympathetic blocks were useful in late cases of trench foot with vasospasm, and that the improvement in treated limbs was faster than in the non-treated contralateral extremities. Although my associates and I were not impressed with the usefulness of sympathetic blocks in the late treatment of trench foot, we obtained conclusive evidence of the benefit of sympathectomy in selected cases. Sympathectomy unfortunately rarely is of aid in alleviating the pain which is so commonly experienced on weight bearing. It is particularly helpful in cases of gangrene, in marked hyperhidrosis, especially if associated with maceration of the skin and secondary infection in reducing the severity of symptoms in patients with sensitivity of the extremity to cold and in certain cases in which there is disturbance of sensation. Patterson found that sympathetic blocks improved temporarily the peripheral pulses, decreased numbness and pain, and abolished hyperhidrosis in the Attu casualties,

but observed that the beneficial effect was limited to the duration of sympathetic anesthesia. Southworth felt that sympathectomy produced beneficial effect upon the late manifestations of immersion foot although it had little effect upon deep pain.

Because such contradictory opinions are held by different observers it is exceedingly difficult to summarize any lessons which may have been learned in the recent war concerning sympathetic interruption in the treatment of the early stages of the injuries due to cold. I think it is fair to say that at least no harm has resulted from the use of such procedures and that their use for further evaluation is warranted. There is much to suggest that they may be very helpful especially if applied early and particularly in cases in which gangrene is threatened or existent. It is my feeling that if transient improvement without permanent benefit is noted following blocks, especially in cases with marked ischemia, one should seriously consider early sympathectomy. With regard to the later stages of these injuries, it is clear that sympathectomy has a definite though limited place in therapy. Though repeated sympathetic blocks may occasionally result in benefit, sympathectomy is generally required. Sympathetic interruption cannot be looked upon in any case as the sole means of therapy. One must, under all circumstances, protect the injured limb from trauma, infection and from external heat in the acute phase. There is much to suggest that anticoagulants should be employed in early cases. Conservatism should be practiced with regard to gangrene and necessary amputations. Physiotherapy and active exercise should be utilized after the acute phase is passed. Shoe corrections, psychotherapy and other means should be used when indicated. It is my opinion that further experiences will confirm the usefulness of sympathetic interruption in alleviating certain complaints late in the course of these disorders and that they may well prove of value in the early stages.

#### SUMMARY AND CONCLUSIONS

The experiences during the recent war have in general confirmed pre-existing impressions concerning the usefulness of sympathetic

interruption in cases of trauma and in the posttraumatic states. Certain new applications of these procedures have been established. The war experiences have been particularly valuable in providing large numbers of cases for study with consequent better evaluation of the specific indications, the merits and the limitations of sympathetic interruption. It would seem that permanent sympathetic interruption may yield gratifying results in some instances in which previous blocks give unsatisfactory results. With regard to certain types of injury there are differences of opinion concerning the usefulness of these procedures. In the presentation of this problem an effort has been made to bring into consideration the studies of various investigators, though the views expressed concerning controversial issues have necessarily been influenced by personal experiences.

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# THE TRANSPORTATION OF SOLDIERS WITH FRACTURES

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THE transportation of a soldier with one or more fractures usually compounded was one of the major medical problems encountered in the European Theater of Operations. In general most of the patients, immediately after wounding were transported by ambulance from the aid stations to the forward hospitals and then by train, boat or airplane to the rear echelon hospitals.

The past standard practices of transporting patients with fractures recommended by the Army Medical Corps were reviewed by the consultants and somewhat modified before the advent of major hostilities on the continent. The major modification was made in regard to the transportation of fractures of the upper extremities.

Almost everyone consulted agreed that the Murray Jones arm splint was an awkward device to apply and it was felt by most doctors that this awkwardness, combined with certain dangers of excessive pressure in the axilla, offset any good factors about the splint. Accordingly the medical officers were not encouraged to use it. Most upper extremity injuries were very simply and easily handled by simply binding the affected arm to the trunk with a sufficient number of triangular bandages. This provided good comfortable immobilization and obviated the necessity of applying a cumbersome piece of apparatus. In addition transportation by litter in an ambulance was a much simpler procedure than it would have been if this splint had been used widely.

Upon arrival at a field or evacuation hospital, or any hospital where surgery on the injured upper extremity was performed a plaster velpau or modified plaster shoulder spica dressing was applied after surgery and was termed a transportation plaster splint for the next stage in the evacuation of the patient.

This splint was either removed and the wound was inspected and the splint then was reapplied or else it was left intact by successive medical officers in the line of evacuation, according to their best judgment. Eventually the patient reached a general hospital where he was to be hospitalized for the next stage of his treatment. At this hospital the "transportation plaster" was removed and appropriate therapy usually skeletal traction was instituted to care for the fracture.

The first splint applied for the transportation of fractures of the long bones of the lower extremity was almost universally the army half ring splint. This was applied at the forward dressing station and remained in place until the patient was received at the field or evacuation hospital for his initial definitive therapy. The ambulance drivers and others responsible for his care during transportation from the aid station to the forward hospital were instructed to release the traction provided by the army hitch which was, in most instances, applied over the patient's shoe of the affected extremity. In the event the foot had been injured together with the long bones of the lower extremity the extremity was simply held in place in the half ring splint by means of triangular bandages, usually five in number and no attempt was made to apply traction. I observed a few individuals arriving at evacuation hospitals who had had undue pressure caused by the army hitch, or who had had the hitch in place many hours without release, but I cannot recall a single instance where any permanent damage was done by this procedure. I was favorably impressed by the comfort with which most soldiers with extensive fractures were transported from forward aid stations to evacuation hospitals in the army half ring splint.

After initial definitive treatment—debridement, etc.—at the field or evacuation hospital these patients, for the most part were encased in one and one-half plaster hip spicas for a

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1. single extremity, or double spicas when both legs were involved and removed to the next hospital in the line of evacuation. These spicas were very well padded affairs. Plaster and padding were split and cut down to the skin up to the hip joint on the affected side. The legs of the plaster were joined with one or more plaster ropes or wooden struts to provide for stability. The patients who were received at ear echelon hospitals in all of these transportation plasters both for the upper and lower extremities, were for the most part remarkably comfortable. Shock was minimized. Pain was not an outstanding complaint, and dressings over the operative areas were retained in place, requiring minimal attention and inspection.

Before the advent of major hostilities in Europe the American Army Medical Corps was given the experience of the British in regard to transportation plasters. The British recommended the use of a hanging plaster for fractures above the elbow joint and the use of Tobruk splints for lower extremity injuries.

The hanging plaster was found by most American medical officers to be unsuitable because it did not immobilize the fracture during a long rough ride on a litter in an ambulance. Most patients complained of pain. The Tobruk splint was not regarded favorably by American medical officers because of the lack of immobilization of a fracture of a femur unless it happened to be just at, or immediately above, the knee joint, and because of the consequent pain the patient experienced.

I myself tried on many occasions to demonstrate a Tobruk splint to American medical officers and had a most difficult time applying it, much more trouble in fact than was experienced in applying the large one and one half or double plaster transportation hip spica.

There were many modifications of the Tobruk splint but, in general it consisted of 1. Adhesive traction straps applied to the skin along the full length of the extremity with padding over the malleoli.

2. An overlying snugly applied long leg plaster splint encasing the foot to provide support and minimize rotation of the extremity.

3. Slots in this plaster in the region of the malleoli through which the traction straps were passed.

4. An army half ring splint supporting the whole extremity in plaster with the traction straps tied over its end.

5. The incorporation of a windlass arrangement in these straps theoretically to provide skin traction to the injured extremity.

Undoubtedly, the British transportation plasters, namely the hanging plaster and Tobruk splint, used less material than did the American army's spicas and velpaus, and also could be applied with the aid of less personnel but the patients were definitely not as comfortable as in the American devices. The British medical units had less material and fewer personnel than did the American counterparts and it is my own feeling that these transportation splints were developed to meet the material and personnel shortages of the British Army.

The Tobruk splint was used upon occasions by American medical officers and an attempt was made by one of the army consultants, Lieutenant Colonel John Manning to follow up all of these cases in the Ninth Army. The number of cases that he was able to contact was nowhere near as impressive as the British figures but the conclusions reached by Lieutenant Colonel Manning substantiated the general belief that (1) There was no uniformity in the types of splints used (2) the transportation of such patients was accomplished with much more pain and discomfort than those encased in plaster spicas (3) the probability of retaining dressings in place in the upper spica was much more difficult then when a splint was used.

Translating these lessons to civilian life it seems to me perfectly logical to recommend the abandonment of the use of the Murray Jones arm splint as a first aid appliance. I believe civilian patients can have upper extremities particularly when the humerus is involved bound rather snugly to the trunk by gauze or elastic bandages and can be transported in comfort. I should certainly recommend the use of a plaster velpau type of dressing if a compounding wound has been suffered which has been debrided or closed in

a patient who must be transferred to some other hospital for long term care. When civilian injuries involving the long bones of the lower extremities are encountered the army half ring splint with foot piece and army hitch reasonably well padded over the dorsum of the foot provides an excellent device for transportation. In the event a compounding wound has been encountered which has been debrided or closed a well padded plaster spica applied to the extremity without regard to the problem of reduction of the fracture serves as an excellent transportation device.

#### CONCLUSIONS

1. The Murray Jones arm splint was felt to be cumbersome and difficult to apply. Much more comfortable and efficient immobilization

was obtained by binding the injured upper extremity to the patient's trunk.

2. The plaster velpau and modified shoulder spicas were preferred to hanging plaster in transporting patients after initial surgery.

3. The army half ring splint with army hitch is an excellent device for transporting fractures of the lower extremity.

4. One and one-half or double hip spica plasters are recommended after initial surgery and are much to be preferred to the British transportation devices labelled Tobruk splints.

5. The above devices, consisting of patent body immobilization plaster velpaus & shoulder spicas, army half ring splints with foot rest and army clove hitch, and plaster transportation spicas can well be recommended for civilian use.

# PENICILLIN IN EXPERIMENTAL INTESTINAL OBSTRUCTION

## A Summary of Observations with Reference to Their Clinical Application

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THE mechanism of death in intestinal obstruction is only poorly understood. Previously death in all types of obstruction was ascribed to a tox-

It is now known that the vomiting associated with high obstructions produces profound chemical changes in the body and that these may be alleviated by the parenteral administration of salt and water. The studies of Wangenstein and others have shown that the relief of intestinal distention does much to reduce associated shock and the hazards of operative intervention. In spite of the advances of recent years in the management of bowel obstructions we still find 1 patient out of every 5 or 6 dying after operation for acute mechanical obstruction of the small bowel (5).

It is thus obvious that more must be learned concerning the pathology of intestinal obstructions in order that new surgical adjuncts can be developed to diminish the hazards associated with such lesions.

When penicillin became available for experimental purposes, we were given the opportunity to restudy certain phases of the intestinal obstruction problem. The factors of bacterial infection and toxemia in the pathogenesis of death from experimental obstruction particularly were reinvestigated.

It is the purpose of this report to summarize our studies on the effect of penicillin in experimental types of intestinal obstruction and to show why the conclusions reached demand

new clinical emphasis on the phases of the problem which were investigated

### PENICILLIN IN ISOLATED LOOP EXPERIMENTS

Prior to our experiments with penicillin in closed obstructed intestinal loops (12) it was known that animals with such lesions would die usually within a week after the creation of the loops in a manner which could best be explained on the basis of a toxemia. The pioneer studies of Stone, Bernheim and Whipple had demonstrated that death in such experiments could not be explained on a basis of vomiting and that septicemia was not a factor. The numerous experiments to prove or disprove the elaboration of toxic substances within isolated loops have been critically reviewed by Cooper (1928), Morton (1929) and Besser (1940). Some investigators, notably Davis and Stone, Murphy and Brooks, Dragstedt and Firor (10), believed that lethal toxins did develop in isolated loop experiments and furthermore that the source of these toxins was bacterial. This latter belief was based on a process of exclusion as there was no positive way to rule out sources other than bacteria for the production of toxins.

In Dragstedt's experiments the isolated loops were washed with ether. The dogs having washed loops survived much longer than did the controls. The possibility was never ruled out in his experiments that the ether might alter the loop mucosa thus interfering with the absorption of toxins of any origin. Firor (10) demonstrated with U shaped loops having both ends open at the surface of the dog's abdominal wall so that periodic through and through cleansing with saline solution could be accomplished that life was prolonged for considerable periods of time after the loops

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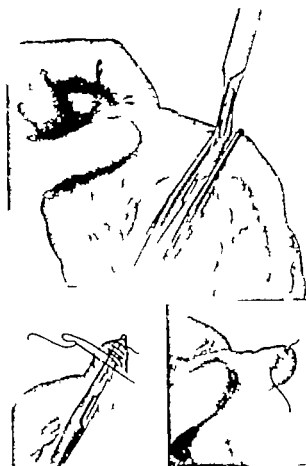


Fig. Occlusion of bowel lumen by transection just above termination of antimesenteric artery of ileum and closure of proximal and distal ends.

were finally closed. The fact that in his experiments the animals eventually died of inanition obscured the mechanism of death in these experiments but again suggested the elaboration of lethal toxins of bacterial origin.

Firor's original suggestion (11) that a modern chemotherapeutic agent (sulfasuxidine) be employed in isolated loop experiments, was, I believe, the greatest contribution to the study of intestinal obstruction since the introduction of the Miller-Abbott tube by Abbott and Johnston. Firor and Poth (11) demonstrated that sulfasuxidine when placed in closed isolated loops, would protect animals with such obstructions for long periods of time. The work was confirmed (13). We had one such animal which was sacrificed over a year after operation. The objection to the sulfasuxidine experiments was that the mucosa was altered

by being covered with a thick paste which could theoretically have interfered with the absorption of toxins of any origin. The observations of Firor and Poth led to the important studies of Sarnoff and Poth (18) and Sarnoff and Fine (19) who reported that sulfasuxidine had a protective effect in dogs with ileal lesions, produced by occlusion of the mesenteric veins, but in which the bowel lumen was unobstructed. Their studies established the important rôle played by bacteria in such lesions, but showed that sulfasuxidine must be present for some time for effective bacterial depopulation of the bowel to occur.

In 1945 it was shown (12) with the use of penicillin either placed in isolated loops or administered parenterally in dogs having isolated loops, that bacteria or bacterial products were responsible for the death of animals in such experiments. Furthermore, the lives of dogs having isolated obstructed jejunal loops could be prolonged for significant periods of time when penicillin was placed in the loop or was given intramuscularly. Thus, in 7 per cent of 15 control dogs with isolated jejunal loops death occurred within 6½ days; 87 per cent died in 3½ days or less. In 100 per cent of 15 dogs, in whose isolated loops penicillin was placed, protection was afforded for 9 days in 93 per cent for 13 days and in 60 per cent for over a month. One hundred per cent of dogs treated parenterally with penicillin were protected for over 18 days. One dog lived over 2 months.

It was widely held at that time that penicillin was not effective against the gram-negative bacilli. This study demonstrated that for all practical purposes, penicillin in large doses was effective *in vivo* against all the intestinal tract bacteria.

It was found that marked distention of the loop occurring in the presence of bacteriostatic agents was compatible with life. In the absence of distention of the loop, an abundant bacterial flora uninhibited by bacteriostatic agents was compatible with life. The experiments indicated that distention must be present before infection of the intestinal wall by the normal intestinal flora can occur. Microscopic and bacteriological evidence was presented to show that penicillin given prophylactically



Fig. 2. Method of tying off mesenteric veins to ileal segment. a, Proximal turned in end b, distal turned in end c, rent in mesentery at distal extremity of segment to be strangulated. (Courtesy *Bull Johns Hopkins Hosp*)

lactically in large doses, whether in a loop or parenterally can prevent infection of the distended intestinal wall by the normal intestinal flora. Recently in experiments employing streptomycin in rabbits with closed loops (created by tying off the base of the large appendix) a similar protective action was demonstrated (9)

#### PENICILLIN IN STRANGULATED LOW ILEAL OBSTRUCTION

In an attempt to produce an obstruction more like that occurring in man and to test a treatment which might be effective for a similar type of obstruction in man Dr John D. Kennedy and the author (3) created strangulated low ileal obstruction in dogs by first completely occluding the bowel lumen (Fig. 1) and then tying off the mesenteric veins to a 60 centimeter segment of the obstructed bowel (Fig. 2). The resulting obstructions were characterized by severe strangulation (Fig. 3). The control dogs' intestines all showed mucosal ulceration and massive bacterial invasion superimposed on the venous infarction which would often be accompanied by perforation. In the first 24 hours following

the production of such lesions there would not always be peritonitis unless perforation had occurred. Later peritonitis developed whether or not there was perforation. The lesions in

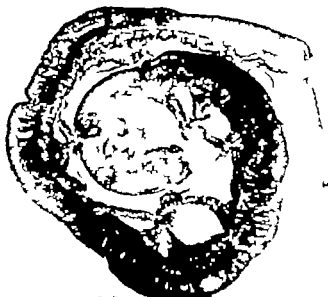


Fig. 3. Strangulated low ileal obstruction showing gross appearance of the resulting hemorrhagic infarction of the bowel wall. The proximal turned-in end is in center of photograph. In this particular case this lesion was resected 72 hours after its production in a dog treated with massive doses of penicillin. The animal was cured.

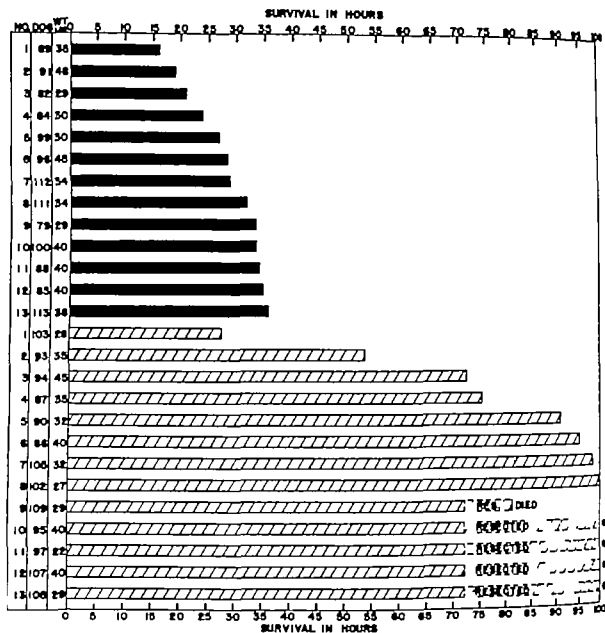


Chart. Diagram showing relative survival times of dogs with strangulated ileal obstructions not treated with penicillin as contrasted with the survival times of dogs with strangulated ileal obstructions treated with penicillin. It can be seen that 4 of the 5 penicillin treated dogs having late resections of their strangulated obstructions were

cured. Both groups were treated equally for hemorrhagic shock, chloride and water loss. Black, postoperative survival time of control dogs with strangulated ileal obstructions. Cross hatch, postoperative survival time of dogs with strangulated ileal obstructions, given massive doses of penicillin parenterally. Black dot, cures.

similar experimental obstructions which had been treated with massive doses of penicillin (100,000 units every 2 hours for 24 hours, 50,000 units every 2 hours during the next 48 hours, and 50,000 units every 4 hours during the remainder of the survival of these dogs whose weight averaged less than 16 kilo-

grams) always showed a well marked bacterial invasion microscopically but this was appreciably less than that which occurred in the controls.

Thirteen dogs, with this type of obstruction treated with whole blood and gelatin solution intravenously and with physiological

saline solution subcutaneously to combat hemorrhage, shock, chloride and water loss died within 36 hours. Seven dogs treated similarly but with massive doses of penicillin in addition survived between 50 and 100 hours (Chart 1). Six dogs lived 70 hours or longer 4 90 hours or longer. In addition in 2 other penicillin treated dogs resection of the strangulated obstructed bowel was performed at 72 hours (a period twice the survival of any control dog) with a cure in each animal. Later in 3 more penicillin treated dogs, resections were carried out at 72 hours, with cure in 2 of the 3 dogs. Thus, there were 5 late resections performed at a time which was twice as long as any dog not treated with penicillin lived. Four of the dogs in which late resections were performed were cured. Drs. Robert J. Caliban and Henry N. Harkins aided us in these latter experiments and we reported the resection experiments with them (4).

In all cases, the control dogs and the dogs treated with penicillin were treated with equal vigor for shock, hemorrhage, chloride and water loss. In 2 of the penicillin treated dogs and 1 of the controls, volvulus of the strangulated bowel converted simple strangulated obstructions into strangulated closed loop obstructions. Thus it was demonstrated that penicillin in the doses employed (which were massive) in the study, could prolong the lives of experimental animals having the type of strangulated obstruction chosen for the study. It was also demonstrated that this prolongation though striking was limited. Whether the limit was set by (1) the final inability of the penicillin in the doses employed to control bacterial infection (2) fatal alterations in metabolic processes and body chemistry (the serum NPN, phosphorus and potassium were elevated, the sodium and chloride were normal to high and the carbon dioxide combining power was low) (3) the presence within the peritoneal cavity of necrotic strangulated bowel, or (4) some combination of these factors, could not be definitely established on the basis of this study. Because of the effect of penicillin in experiments with nonstrangulated closed loops, however, it would appear that the effect of penicillin would be much more striking in obstruction in which the de-

gree or amount of strangulation was less marked.

These studies demonstrated that bacteria play an important rôle in the 'toxemia' and death in dogs with strangulated ileal obstructions and that aggressive antibacterial therapy in the form of frequent, massive doses of penicillin is effective to a significant extent in treating such lesions.

#### THE FIELD FOR PENICILLIN THERAPY IN HUMAN INTESTINAL OBSTRUCTION

In a study of 204 cases of acute complete mechanical obstruction of the small bowel, in which patients were operated upon at the Johns Hopkins Hospital during the 10-year period 1936-1945 there was an overall mortality of 20 per cent (5). When this mortality rate was corrected for deaths due to cardiac, pulmonary, and other causes not directly related to the intestinal obstruction the mortality rate was 15 per cent. Of the 41 deaths in the series, over half were due to peritonitis. In 27 per cent of all cases the bowel was strangulated at operation. In an additional 5 cases although the bowel was considered viable by the surgeon at operation gangrene and necrosis were found at autopsy. The strangulated cases accounted for over half of all the deaths due to peritonitis. The study confirmed the statement of McKittrick and Sarrs that 'the factor of strangulation is the greatest single factor determining the outcome of a case of intestinal obstruction' and showed that there is a fertile field for an adjunct against bacterial infection in intestinal obstruction. Indeed it would seem that no further great reduction in the present mortality rate can be made until bacterial infection and 'toxemia' are combated.

#### DISCUSSION

Evidence has been presented which demonstrates the important rôle played by bacteria in death resulting from the types of obstruction studied. Furthermore it has been shown that the lethal effects of bacterial growth can be significantly obviated by massive doses of penicillin. It should be stated here that the exact mechanism by which bacteria produced their lethal effects in our experiments is not



clear. We feel that the ascribing of all deaths in experiments of this nature to peritonitis is an over-simplification of the problem (14). At any rate it would seem that the beneficial results of penicillin therapy noted in our experimental animals, could be applied directly to man. Human studies have revealed that the problems of strangulation and infection are grave ones and also that the presence of strangulation is often impossible to diagnose, especially in patients with early cases short of direct visualization of the affected bowel wall.

When these factors are combated in experimental animals life is prolonged and significant protection is afforded.

#### CONCLUSIONS

1. A clinical trial of massive antibacterial therapy for acute mechanical small bowel obstruction in man is warranted.

2. It is believed that such a trial would significantly lower the present intestinal obstruction mortality.

3. Penicillin should be regarded as an adjunct to early and adequate surgical intervention in acute obstruction and not as a means to delay operation.

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THE changes which have come about in the surgical treatment of amputations due to the recent war effort and which are adaptable to use in civilian life have been chiefly the result of good planning and organization for the care of these cases. The early establishment of the use of sound surgical principles and practices for the early and immediate care and transportation of war amputations and implementation of these policies by authoritative directives was an important part of this planning. This together with the establishment and organization of special centers for definitive care and rehabilitation contributed more than anything else to whatever changes for the better there may have been in surgical treatment. The modern advances in medicine, medical education and graduate education played the rôle of making a higher standard of practice of medicine and surgery available, but all these would have amounted to very little had it not been for proper organization. (5) This brought the patients together under the direction of highly specialized surgeons who had the responsibility for not only organizing the whole functioning of the center with all its different departments but for all of the complete care of the whole patient and all of his problems. Even here in the amputation centers the value of organization could hardly be overestimated. For truly surgery is not the end but one of many means to the end in this field. Besides organization it was chiefly due to the fact that the surgeons were in complete charge of all of the amputee's problems from the time of his amputation until he was fitted with a limb and trained to use it that better surgery was done with better results than ever before. (1)

These are the important lessons learned from the War and herein lie the hints for the wise if service is to be improved for civilians in the future. It is of course impossible and

unnecessary to duplicate the war services in civil life but it would be a simple matter indeed to establish organized amputation services in the larger civilian hospitals, just as fracture and other special services were developed in the past. The management of amputations would then improve just as fracture treatment has. There is no obvious reason why existing limb makers could not co-operate completely with the surgeons in this matter just as brace makers always have. There can be no quarrel between surgeons and limb makers. The ultimate aim of both should be to give the patient the best possible care. If either or both fail in this important task they may find someone else doing their work for them. For if something is not done to improve the care of civilian amputees the federal agencies may justifiably take over the whole problem including especially the manufacture and fitting of artificial limbs.

## SURGERY

The strongest trend in the surgery of amputations has been toward more conservatism. This has been true both in the immediate surgical treatment and in the definitive surgery. The general use of the modified guillotine amputation at the lowest possible level resulted in the saving of more of the limb than ever before in war or civil life both at the time of primary amputation and finally when definitive surgery was done. The more complete understanding of the problem of the amputation stump in its relation to the prosthesis by the surgeons has resulted in a more conservative surgical attitude with a marked tendency to leave as much stump length as possible and to fit the remaining stump with a prosthesis regardless of its length. The chief exception to this is amputations below the knee of more than 7 inches in length. One of the truly great lessons learned was that the problems of the surgery of the stump are so closely related to those of the prosthesis that it is impossible to completely understand one without under-

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standing the other and that they cannot be separated from one another. Since the surgeon is the only one who can understand all of the problems, particularly these two, he is the only one who is or ever will be qualified to properly supervise and direct the whole care of the amputation stump and the patient.

The important changes that have come about in the surgical treatment of amputations, then, have not been due to the development of new operations, techniques, or methods. Rather they are due to organization, good judgment, good surgery, and most important, the complete responsibility of surgeons for the whole patient and all of his problems. The problem is an arduous one and nothing has been found which will take the place of hard work and the greatest attention to details.

1. *The open or modified guillotine amputation.* The routine use of this method of amputation in the United States Army has again proved to be the safest and best method for use in war notwithstanding some opinions to the contrary. Although long skin flaps which tend to close the wound prematurely are undesirable, it is important that viable skin be conserved at least equal in length to the bone. The use of the modified guillotine amputation at the lowest level consistent with proper débridement without regard to the final site of amputation, with proper skin traction until the stump is ready for final revision or reamputation, has proved to be of such great value in the war that it must find greater use in contaminated civilian cases. The stump is ready for revision or reamputation in from 3 to 8 weeks post-operatively, depending upon the case. Reamputation at a higher level, when indicated, can be done much earlier than revision at or near the stump end. This is one of the reasons why the original open amputation should be done at the lowest possible level. The stump is ready for revision when the skin has been pulled well down over the stump end, drainage has ceased, swelling has subsided, and the remaining open wound is clean. Routine bacteriological examination of the stump wound is advisable before the final operation is done. It is not necessary or desirable in the majority of cases to wait for complete healing to take place. (6)

The use of skin grafts on amputation stumps is mentioned only to be condemned. They are distinctly disadvantageous in that they stop the whole normal healing process and they are poor substitutes for the normal skin which can easily be drawn down over the stump-end by traction. When skin grafts are used they interfere with the function of the stump in the prosthesis by breaking down to such an extent that they should routinely be removed and traction applied until the skin can be closed. The removal of skin grafts from stumps for use elsewhere is equally to be condemned as the donor area causes difficulty when the prosthesis is applied.

2. *Essential points in amputation.* (a) The operation should be done with the use of a tourniquet whenever possible. The use of the tourniquet can be extended by the use of Wyeth pins on short thigh stumps.

b. Definitive operation should be done in a clean field and under careful aseptic precautions.

c. Except in end-bearing stumps, the skin flaps should be cut equal in length so that they meet in the center of the end of the stump without redundancy. A general rule for estimation of the length of the skin flaps is to cut each flap approximately two-thirds of the length of the radius of the limb. The stretching of the flaps, which then results after under-cutting, permits them to lengthen sufficiently for closure.

d. The deep layer of fascia is reflected with the skin flap in primary amputation whenever possible. The muscles are divided slightly distal to the saw line so that after retraction has taken place the end of the muscles will be at the level of bone section.

e. The periosteum is sharply divided at the level of bone section.

f. The main nerves are gently pulled down, smoothly divided, and allowed to retract out of the stump end. Nerves are not ligated, cauterized, infected, or otherwise treated by any fancy technique.

g. The tourniquet should be removed after the main vessels have been ligated and complete hemostasis obtained. The skin flaps are closed by simple interrupted skin sutures. The use of subcutaneous and stay sutures is not

only unnecessary but contraindicated in that they further traumatize already ischemic flaps.

h Drainage should be used more or less routinely for 24 to 48 hours in all amputation stumps because of the tendency for postoperative drainage from the mass of sectioned muscle and from the bone.

3 *Postoperative care* There is no substitute for complete bed rest, elevation and proper splinting in amputations below the knee until complete wound healing has taken place. A period of at least 3 to 4 weeks is required for proper healing of these cases. Other amputations may heal in less time. Postoperative splinting is preferable to skin traction even in cases in which the skin flaps are tight. Amputations through, or above, the knee should not be elevated as this causes flexion contractures. These patients particularly bilateral above the knee amputees should be turned face down at intervals whenever possible to prevent contractures. The routine use of elastic bandages for compression dressings has been found to be of great value.

Exercises designed to overcome contractures and to strengthen the muscles of the stump are started as soon after wound healing as possible. Wrapping of the stump with elastic bandages for stump shrinkage when properly carried out has proved to be of great value. Exercises and wrapping are the only two forms of physiotherapy which are of value. Massage is always contraindicated as it may be harmful and is of no value.

Occupational therapy has proved to be important both in keeping the patient's mind occupied while he is waiting and also in the training of the use of the arm prosthesis.

4 *Extension grafts* The extension of the bone length of certain stumps when the normal soft tissues were present but were devoid of a considerable length of bone proved to be a practical and valuable procedure in certain cases particularly in amputations above the elbow. The fibula has been successfully used as an intramedullary extension graft in the medullary canal of the humerus.

The use of extension bone grafts on amputation stumps where any type of skin graft is required to extend the length of the stump is probably not justified in most cases in view of

the disappointing results obtained. This is true of arm stumps as well as various types of amputations of the hand, thumb and fingers.

5 *Homogenous bone and bone bank* The successful use of freshly transplanted homologous bone grafts in a number of patients with multiple injuries and amputations who had no bone graft donor site led to the limited use of a bone bank at the Thomas M. England General Hospital. The bone was collected from clean reamputations and stored in an ordinary electric refrigerator in glass jars containing normal saline solution saturated with sulfanilamide. The use of bone preserved in this manner was not great enough to warrant conclusions as to its value but the experience was sufficient to suggest further experimentation with the method. This experience did prove beyond doubt that freshly transplanted homologous bone gave good final end results in a high percentage of the cases. These results will be published in a subsequent paper.

6 *Sulfa drugs and penicillin* The use of medication of this type has undoubtedly been helpful in combating serious infections and has saved time in some cases. The routine preoperative and postoperative use of medication of this type however has not been proved to be of outstanding value.

#### SITES OF MAJOR AMPUTATIONS

1 *Amputation of all digits at or near the metacarpophalangeal joints* Phalangization of the metacarpals, with complete removal of the second and third and sometimes the fourth metacarpal bones, and plastic closure of the remaining defect with the formation of a deep cleft was found to be the best solution to this problem type of amputation. The remaining digits thus formed have the advantage of sensation, active motion and prehension. They were so capable of function that all patients operated upon were completely satisfied with the results. The function thus obtained is in some ways similar to that of a Krukenberg stump. This type of stump is very satisfactorily fitted with a cosmetic hand which is used on occasions when active function of the stump is secondary to cosmetic appearance. The technique of this procedure will be described fully in a subsequent article.

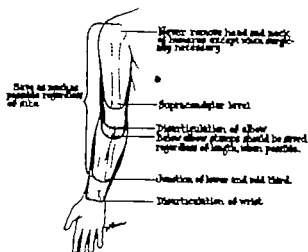


Fig Sites of major amputations in upper extremity

2 *Amputation at the wrist joint* Amputation at the wrist joint has been revived both in this country and in Europe. The carpal bones should be conserved if possible, but if not disarticulation without them is satisfactory. Amputation at this site conserves length and when properly fitted with a prosthesis there is some useful pronation and supination. The prosthesis does not extend above the elbow. Amputation at the wrist is somewhat more difficult to fit with a prosthesis than amputation at the junction of the lower and middle third of the forearm but this can usually be overcome by effort and experience. There have already been many improvements in the prosthesis for amputations at the wrist both here and in England (4).

3 *Amputation at the junction of the lower and middle third of the forearm* If amputation through the wrist is impossible the next level of choice is at this level or approximately 2 inches above the styloid process. Before the war this was the standard site of amputation in the forearm and was preferred by most surgeons and limb fitters. All possible length should be saved above this level.

4 *Short below elbow stumps* All length possible should be saved below the elbow since improved methods of fitting have resulted in greater ability to fit these short stumps than ever before. It is possible to fit satisfactorily below the elbow stumps as short as one-half inch in length. The relative stump length may be slightly increased by resection of the biceps

tendon at the time of final operation. This can easily be done by reflecting the anterior flap without the necessity of making a separate incision (3a).

5 *Disarticulation of the elbow* Amputation at this level was found to be more useful than it had previously been thought to be. It is preferred to amputation at the supracondylar level wherever possible as it gives the stump longer leverage and when properly fitted the patient has better control of the prosthesis, particularly in performing internal and external rotation movements. The prosthesis is fitted with side joints and the type of prosthesis is similar in principle to that used for end bearing thigh stumps.

6 *Amputations at the supra-condylar level.* This is still the standard site of amputation above the elbow. The supracondylar amputation should be left as long as possible. The site of bone section is immediately above the condyles of the humerus. Above this level all possible stump length should be saved.

7 *Short above elbow stumps* A stump at least 2 inches in length below the axillary fold is necessary for the active use of a prosthesis. If the stump is shorter all possible bone should be saved including the head and neck of the humerus, despite the fact that amputations at this level will be fitted as disarticulations of the shoulder. Attempts to increase the relative length by section of muscles and tendons have proved disappointing.

8 *Disarticulation of the shoulder* Disarticulation of the shoulder should never be performed except where surgically necessary. The head and neck of the humerus should be conserved wherever possible for contour and normal appearance. This surgical conservatism also results in better prosthetic fitting and improved prosthetic accomplishment.

#### SPECIAL METHODS FOR USE IN UPPER EXTREMITY<sup>1</sup>

*The Krukenberg operation (or stump)* The Krukenberg method consists of surgical separation and phalangization of the radius and

<sup>1</sup>The basis for the statements used in connection with the Krukenberg and elastic methods was personal observation at the American Occupied Zone in Germany, when the author was member of the Army Surgeon General's European Commission on Amputations and Artificial Limbs (1946).

ulna so that the resulting claw shaped stump is capable of some prehension and has the advantage of sensation. The use of this procedure is limited to amputations below the elbow of at least 11 centimeters in length from the lateral epicondyle. Although the method has been widely used in Germany particularly on bilateral amputees with or without eyesight, it probably would not meet with general acceptance in this country. The use of the Krusen-berg method, however, should be valuable in the surgical treatment and rehabilitation of all blind bilateral amputees.

**The Clineplastic method** The only form of cineplasty still in use is the muscle tunnel type of Sauerbruch. It is still widely used by some surgeons in Germany and the surgical technique has recently been improved considerably. The use of this method has been limited in this country and discontinued in most others chiefly because of inadequate prosthetic facilities. There has recently been considerable renewed interest in cineplasty but extensive use of the method must await further prosthetic research and development which is being carried on by the Committee on Artificial Limbs of the National Research Council. When this work has been completed the method may well be subjected to more extensive trial use when its true value in this country can be finally determined.

#### LOWER EXTREMITY

**1 Amputations through the foot** Partial amputations of the foot up to the Chopart level can usually be fitted with shoe corrections and appliances so that they will give very satisfactory function. One of the important lessons learned in the recent War was that the Chopart amputation could not usually be fitted with anything in the way of a shoe correction or a prosthesis which was satisfactory. The Syme amputation is therefore almost always preferable to the Chopart. Much time worry and dissatisfaction can be prevented on the part of the patient and surgeon by the early and immediate application of the Syme amputation to almost all of these cases. Attempts to improve the function of the Chopart amputation by subastragalar and ankle joint fusion have usually been unsuccessful.

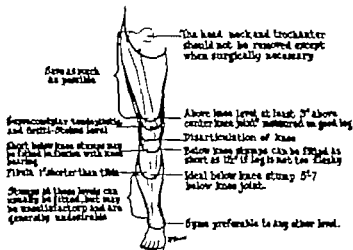


Fig. 2 Sites of major amputations in lower extremity

Center of knee joint is the center of axial motion which is located in the center of the femoral condyle,  $\frac{3}{4}$  inch above the joint line.

**2 The Syme amputation** The Syme amputation when properly performed under the proper circumstances is preferable to any other major amputation in the lower extremity. It is the only amputation recommended at the ankle. The use of amputation at the ankle was greatly revived in this country during the recent war although it had previously been used only to be generally forgotten. Details concerning the Syme amputation during the War have been published in two previous articles (2, 3).

**3 Amputations below the knee** Although amputations in the lower third of the leg above the Syme level may be satisfactory in some cases they are not generally favored, because of poor circulation. The ideal level of amputation below the knee is generally accepted to be five to seven inches below the knee joint. Most surgeons, who have had the greatest experience, prefer a length of not over 5 to  $5\frac{1}{2}$  inches below the knee joint. The use of partial or complete ischial weight bearing has been found to be useful in fitting many imperfect below the knee stumps.

**4. Short below the knee stumps** The fibula should be completely removed in all below the knee stumps shorter than  $3\frac{1}{2}$  inches and these may be fitted as short as  $1\frac{1}{2}$  inches below the knee joint if the leg is not too fleshy. Success in fitting these short stumps depends upon the proportion of length to width. Stumps with little soft tissue covering there

fore are more favorable at this level. Some of these short stumps are advantageously fitted with considerable end weight bearing. Section of the hamstring tendons may give additional relative length to the stump in some cases (3a).

5 *The flexed leg stump (bent knee)* Below the knee stumps, which have for any reason definitely proved to be unsatisfactory or are too short for fitting as below knee stumps, may be flexed to 90 degrees and fitted very satisfactorily with a prosthesis with full weight bearing on the bent knee. If sufficient stump length projects posteriorly in this type of fitting it has the advantage of full end bearing without the necessity of any type of belt or suspenders for suspension of the limb. This is one of the oldest methods of prosthetic fitting in the lower extremity the use of which has been revived in the War.

6 *Disarticulation of the knee* Amputations at this site may give excellent results in some cases. It is important that the greatest care be exercised in performing amputations at this level. Unless good healing and full end bearing are obtained the results may be disappointing.

The patella is left in position without removal of the cartilage unless more length is desired in the anterior flap. Removal of the patella in such cases may result in considerable additional relative length of the anterior flap. The cartilage of the femoral condyles is not removed. It is important that the hamstring muscles be sutured to the patella tendon in the intercondylar notch to prevent separation of the skin flaps. When properly fitted with a prosthesis most of these cases need no pelvic or shoulder suspension of the limb since accurate fitting of the socket to the bulbous end of the stump secures it in place.

7 *Supracondylar amputation of the thigh* The supracondylar tendoplastic amputation apparently gives equally as good results as the Gritti-Stokes. The only difference in these two amputations is that the patella is excised in the supracondylar tendoplastic procedure, whereas it is fixed to the end of the femur in the Gritti Stokes. The supracondylar tendoplastic amputation has the advantage of being

a simpler surgical procedure than the Gritti Stokes. The former was more commonly used in the Army amputation centers than the latter.

8 *Amputations above the knee* In amputations above the supracondylar Gritti-Stokes level the end of the stump should not be longer than 3 inches above the center of the knee joint.<sup>1</sup> Many surgeons of great experience prefer an ideal length of not over ten to twelve inches from the trochanter. If amputations of the thigh are longer than 3 inches above the center of the knee joint, it will be necessary for the prosthetic maker to make the thigh piece longer than the normal thigh, and the shin piece shorter than normal so that the knee joint of the artificial limb can be incorporated. All possible length should be saved above this level.

9 *Short above the knee stumps* It is possible for above the knee stumps as short as 2 inches, measured from the crotch to be fitted as above the knee amputations. Here again this depends somewhat on the proportion of length to width the thinner ones being preferable. If a short thigh stump proves to be too short to be fitted as an above the knee amputation it may be fitted with a tilting table as a hip joint disarticulation when the stump is flexed to 90 degrees. The head, neck, and trochanter should never be removed except when absolutely necessary as the presence of this structure helps to stabilize the prosthesis and it conserves the normal contour of the pelvis.

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<sup>1</sup>Center of the knee joint is the center of axial motion, which is located in the center of the condyle of the femur about three-fourths inch above the knee joint.

# ADVANCES IN BONE GRAFT SURGERY ATTRIBUTED TO WORLD WAR II

GEORGE K. CARPENTER, M D F A C S Nashville, Tennessee

**B**ONE graft surgery as performed by the military surgeons during the early months of World War II was little different from that performed in civilian life. Sound civilian surgery became good military surgery. The advances derived from war experience should now be applied to present day civilian practice.

Experience has shown that better end results are obtained when both the patient as a whole and his extremity are effectively prepared for bone graft surgery. The patient's general condition should be at its best prior to surgery. Blood transfusions are often indispensable in rendering the patient in optimum condition for surgery. It has been well shown by Brown Shaw, Mech and others that existing scar tissue must be appropriately treated prior to bone graft surgery. Once nonunion is accepted, the extremity is subjected to a well supervised preoperative program of physical therapy which is outlined to improve circulation and muscle tone and to mobilize the joints.

Presented in the symposium on Fractures and their Trauma before the Clinical Congress of the American College of Surgeons, Cleveland, Ohio, December 16-20, 1946.

Chemotherapy plays an important rôle in bone graft surgery. This is particularly true since nonunion so frequently follows a compound fracture. Chemotherapy will not permit bone graft surgery in the presence of infection. It is our practice to delay bone graft surgery until approximately 3 months following complete wound healing. The time interval between complete wound healing and bone grafting may vary somewhat depending upon the character and duration of the infection but it is safer for the patient if the surgeon waits longer than was necessary rather than to operate too early. It is our practice to employ adequate penicillin therapy for 2 days prior to surgery and for approximately 5 days following surgery.

It is believed that nonunion is too often not recognized and accepted in an early stage and as a consequence bone grafting is frequently unnecessarily delayed. So called delayed union usually progresses to nonunion. To treat delayed union for 3 months and at the end of this time find that bone graft surgery is necessary is most time consuming to the patient. Prolonged immobilization is detrimental to restoration of function. The morbidity of a



Fig 1

Fig 2

Fig 1 Case 1 Nonunion of 6½ years duration in an 8 year old child

Fig 2 Case 1 Three and a half months after bone graft with iliac bone



fore, are more favorable at this level. Some of these short stumps are advantageously fitted with considerable end weight bearing. Section of the hamstring tendons may give additional relative length to the stump in some cases (3a).

5 *The flexed leg stump (bent knee)* Below the knee stumps, which have for any reason definitely proved to be unsatisfactory or are too short for fitting as below knee stumps, may be flexed to 90 degrees and fitted very satisfactorily with a prosthesis with full weight bearing on the bent knee. If sufficient stump length projects posteriorly in this type of fitting it has the advantage of full end bearing without the necessity of any type of belt or suspenders for suspension of the limb. This is one of the oldest methods of prosthetic fitting in the lower extremity, the use of which has been revived in the War.

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Fig 1

Fig 2

Fig 1 Case 1 Nonunion of 6½ years duration in an 8 year old child  
Fig 2 Case 1 Three and a half months after bone graft with iliac bone.



Fig. 3.

Fig. 4.

Fig. 3. Case 2. Nonunion 5 months following injury.  
Fig. 4. Case 2. Three months following healing inlay bone graft.

fracture is in direct proportion to the extent and duration of the disability and its associated economic sequelae.

In cases in which the surgeon is reasonably assured that nonunion is inevitable bone grafting should not be delayed except as is necessary to fulfill the usual prerequisites for bone graft surgery. Unless the surgeon is reasonably assured that so called delayed union will soon progress to solid bone union it is believed that bone grafting should be performed without delay. Carpenter



Fig. 5.

Fig. 6.

Fig. 5. Case 3. Nonunion 5 months following severe compound fracture.

Fig. 6. Case 3. 7 months following onlay graft.

Rosenfeld and Mech have described the treatment of limited union by reinforcement bone grafts as a procedure planned to shorten the time needed to obtain a bony union of sufficient size and strength to permit early and unprotected function of the extremity. This treatment of limited union decreases the disability and thereby reduces the morbidity of the fracture.

A patient with nonunion requires a careful consideration of the individual problem at hand and a method of procedure is planned which will assure the maximum of function in the minimum of time. Needless to state, the



Fig. 7.

Fig. 8.

Fig. 7. Case 4. Nonunion of radius 6 months following severe compound fracture. Healing complete for 3 months.

Fig. 8. Case 4. Roentgenograms showing union 7 weeks after onlay graft.



Fig. 9.

Fig. 10.

Fig. 9. Case 5. Nonunion of radius 4 months after injury.

Fig. 10. Case 5. Roentgenograms 6 weeks after onlay graft.

procedure of choice must be a safe one for the patient, and this will necessitate sound surgical judgment and respectful understanding of morbidity. Cancellous bone such as that obtained from the wing of the ilium offers exceptional qualifications as the graft of choice. It is ideal for a spinal or sacroiliac fusion and in nearly all joint fusions which necessitate the use of autogenous bone. Unfortunately the usual bone graft operation for nonunion is performed with the patient on his back, and since the posterior wing of the ilium presents the better donor site, certain technical difficulties most often make the ilium an impractical site from which to obtain the grafts. Adequate internal fixation of the fracture site is very advantageous and can be better obtained by the application of an onlay graft with screw fixation. Cancellous bone in lesser quantities can, of course, be obtained from the tibia. The tibia serves as the best donor site in the majority of cases. Multiple chip grafts as can be obtained from the tibia, also serve to stimulate osteogenesis.

The long bones may be better grafted by the application of long tibial grafts with cancellous bone and chips packed about the fracture site and along the graft. Two to four screws will as a rule adequately maintain in



Fig. 11

Fig. 12

Fig. 11 Case 6. Nonunion of humerus 4 months after severe compound fracture. Wound healing complete for 3 months.

Fig. 12 Case 6. Roentgenograms 8 weeks after onlay graft.

ternal fixation of the fracture and graft. Frequently in nonunion of the femur the fracture is fixed by the application of a six screw metallic plate to facilitate postoperative treatment in a Thomas splint and a Pearson attachment traction apparatus. Nonunion of the femur thus treated by the application of a metallic plate in addition to a tibial graft and cancellous bone eliminates the use of plaster and permits early knee motion. Although it is believed that positive fixation of the fracture and of the graft very materially hastens the union, such treatment is not always employed.



Fig. 13

Fig. 14

Fig. 13. Case 7. Seven and a half months after fracture of femur.

Fig. 14. Case 7. Seven months after application of onlay graft and plates.



Fig. 15

Fig. 16

Fig. 15. Case 8. Two and a half months after fracture of femur.

Fig. 16 and 17. Case 8. Five months after onlay graft and plate.

As a general rule plates and screws are used sparingly. If at all in treating a case of nonunion which previously showed infection even though wound healing had been complete for at least 3 months. Bones well covered with muscles, such as the shaft of the humerus and femur will tolerate plates and screws much better than such locations as the lower third of the tibia. The site of the nonunion should be cleared of scar tissue and sclerotic bone, but when extensive infection has been present, it may be unwise to treat the fracture site. An onlay graft may be reasonably expected to take without performing an extensive resection of scar tissue and sclerotic bone. A sliding inlay graft is an excellent procedure for treatment of nonunion of the tibia following a simple fracture but when nonunion follows a compound fracture of the lower third of the shaft of the tibia an onlay graft, without screw fixation is applied to the lateral aspect of the tibia. Intermedullary grafts are rarely if ever used. With loss of substance multiple grafts with much cancellous bone and chips are employed in an effort to restore the bone to its normal size. It is imperative that plenty of bone be used in every case. The surgeon must be ingenious and resourceful and an exponent of sound surgical principles.

#### SUMMARY

The advances in bone graft surgery emanating from the experiences of World War II which are equally applicable to civilian practice are briefly as follows:

1. A full appreciation of the value of rendering the patient in optimum condition for surgery and maintaining his blood and nutritional requirements throughout the convalescence, as so well described by Lyons.

2. Like the patient as a whole, the extremity itself is likewise put in optimum condition for surgery.

3. Chemotherapy will permit the infected compound fracture with nonunion to be grafted earlier but never until the elapse of an adequate time interval following complete wound healing.

4. An early recognition of nonunion will permit grafting as soon as the usual prerequisites for bone graft surgery are satisfied.

5. Adequate internal fixation of the fracture and of the graft preferably by using screws and a tibial graft seems to stimulate the osteogenetic activities of the graft and is desirable except when the site of fracture was previously the seat of an extensive infection.

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# FRACTURE OF THE CARPAL SCAPHOID

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THE navicular of the hand is invariably called the scaphoid by those who write of its pathologic state. Obletz and Halbstern (1) described the nutrient foramina on which the blood supply of this bone depends. The largest and most numerous of these foramina are distal to the constricted portion called the waist by clinicians. These writers concluded that a complete fracture at the waist would seriously interfere with the blood supply of the proximal fragment in about a third of the cases. *This is the important factor in the healing of these fractures.*

**Mechanism** These fractures are due to indirect violence transmitted from the outstretched hand along the radial axis of the hand and forearm. These radial axis injuries are in order of sequence but not frequency as follows (1) fracture of the first metacarpal bone (2) fracture of the greater multangular bone, (3) fracture of the carpal scaphoid (4) perilunate posterior dislocation of the carpus (5) Colles fracture (6) fracture of the head of the radius. These lesions occur separately and in combination (Fig 1 and Fig 2). In the younger age group such as we had to deal with in the armed forces whose strong muscles resist the indirect violence fracture of the carpal scaphoid occurs 4 to 5 times as frequently as Colles fracture. In the more elderly with flabby muscles the wrist immediately extends and Colles fractures predominate.

**Clinical recognition of the fracture** If after a fall on the outstretched hand or similar trauma, the patient complains of pain at the radial side of the carpus, inability to grasp firmly, and shows no obvious deformity but constant, definite tenderness in the interval between the long and short extensor tendons of the thumb a fracture of the carpal scaphoid should be assumed to exist until its absence is proved by roentgenogram.

Presented to the symposium on Fractures before the Clinical Congress of the American College of Surgeons, Cleveland Ohio December 16-20, 1946.

**Roentgenography** The use of the roentgenogram as an aid to diagnosis in a very high percentage of wrist injuries led to the discovery of an enormous number of these carpal scaphoid fractures in the armed forces. A complete or widely displaced fracture may be immediately revealed by the first roentgenogram in conventional positions. At times the first roentgenogram will fail to reveal the fracture which will be readily seen 2 weeks later due to absorption at the fracture line. Those views which show this fracture to best advantage are (1) an anteroposterior with the hand in marked ulnar deviation and (2) a postero-anterior in 45 degree angle oblique projection.

**The fracture** A few of these fractures occur at the tuberosity where the transverse carpal ligament is attached. These avulsion fractures heal uneventfully in short order.

The fracture under consideration occurs at the waist and heals according to the blood supply which remains to the proximal fragment. Fractures with an adequate blood supply to the proximal fragment should heal with 8 to 10 weeks of immobilization while those with an

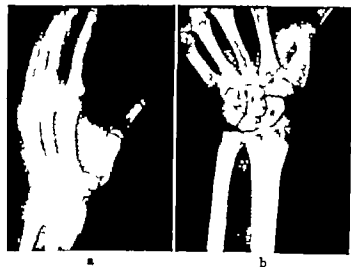


Fig 1. Cpl. S.F. Jeep accident December 16, 1945, Korea. Plaster splint was applied immediately. a, Earliest roentgenogram available March 15, 1946, shows healed fracture of left first metacarpal bone fracture of left carpal scaphoid unhealed. b, Roentgenogram 3 months later June 13, 1946, carpal scaphoid healed. This case illustrates a combination of two radial axis injuries.

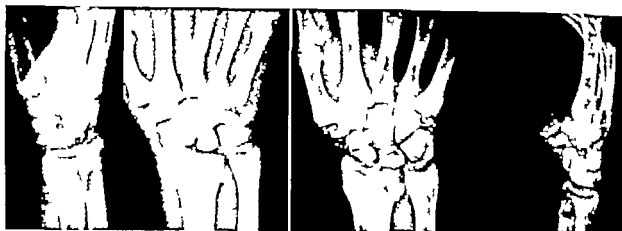


Fig. 2.



Fig. 3b.

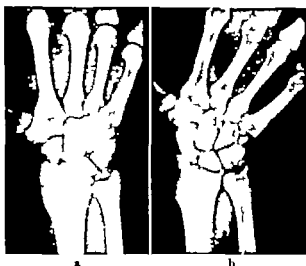


Fig. 3. Cpl. E.M. June 2, 1945 France. Fall on outstretched right hand. Treated 3 months as *peine of wrist*. a, Roentgenogram November 3, 1945, 3 months after injury showing fracture of right carpal scaphoid with marked absorption at fracture line. b, Roentgenogram, July 3, 1946, 3 months after injury shows carpal scaphoid fracture healed. This soldier was disabled 3 months, at least 8 mo. longer than necessary because his injury was unrecognized.

Fig. 2. Pvt. H.L.B. Jeep accident November 6, 1945, France. Injuries recognized and treated immediately. a, at left, Roentgenogram of right wrist showing perilunate dislocation, a complete badly separated fracture of the scaphoid. a, at right, Roentgenogram of left wrist on day of injury showing fractures of greater multangular, carpal scaphoid and Colles. b, at left, Roentgenogram of right wrist July 30, 1946, 8 months after injury. Dislocation reduced, scaphoid fracture ununited. a, at right, Roentgenogram of left wrist July 30, 1946, 8 months after injury. Fracture of greater multangular and Colles are ununited. Carpal scaphoid ununited. This case is shown as *bilateral carpal scaphoid fracture with three other associated radial axis injuries in the two wrists*. This soldier refused further treatment, stated that his symptoms were minimal. He could do his civilian job and requested discharge from the service.

inadequate blood supply will require up to 20 weeks or longer before healing ensues. Unfortunately there is no means of determining in advance into which group any given fracture of the scaphoid falls.

#### TREATMENT

Treatment of the fracture is by prompt immobilization of the wrist in a glove type circular plaster splint extending from just below the elbow to the distal palmar flexion crease, allowing full motion in the fingers. The wrist is in slight dorsal flexion. The thumb is usually immobilized in anatomic position beyond the distal joint. Various positions of the thumb have been advocated with equally good results reported. This does not appear to be a vital factor.

Since no complete fracture of the carpal scaphoid through the waist heals in much less than 8 weeks, plaster immobilization should be continuous for this period. The plaster splint is then bivalved, a roentgenogram is

taken, and the splint immediately reapplied. If the fracture is united the splint is discarded. If union of the fracture is doubtful a new circular plaster splint is promptly applied. If this roentgenogram reveals the proximal fragment with its original density while the distal fragment shows atrophy, there is definite evidence of interference with blood supply to the proximal fragment, and prolonged immobilization of the wrist up to 20 weeks or longer may be indicated.

#### RESULTS OF TREATMENT

Shands reported that 195 of 198 carpal scaphoid fractures treated by trained orthopedic surgeons in 6 Army Air Force hospitals resulted in union an incidence of 98.5 per cent. Oblatz (2) reported in greater detail a series of 28 carpal scaphoid fractures from an Army Ground Force Hospital. He personally

followed these cases until plaster splints could be discarded. Union occurred in every case without aseptic necrosis in a single instance.

These 2 instances are, of course, optimum results obtained by experts. Experience gained by the medical officers of the armed forces offers to civilian surgery two salient facts about this fracture: (1) it is a common injury; (2) with complete knowledge of the problem and proper treatment based on that knowledge, a high percentage of those fractures will heal.

Beware of a diagnosis of sprain of the wrist joint<sup>1</sup> (Fig. 3.)

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## MANAGEMENT OF COMPOUND FRACTURES IN THEIR EARLY PHASES

OSCAR P HAMPTON Jr M D F A C S St Louis, Missouri

THE advances during World War II in the management of compound fractures in their early phases came not only in improved techniques of excisional surgery in forward hospitals and in the broad application of specific procedures such as delayed closure of the compounding wounds and surgical incisions or delayed internal fixation of malaligned compound fractures several days later in base hospitals, but of greater importance in a change of concept for the management of these wounds. Moreover the basic principles of the science of surgery itself were irrevocably reaffirmed.

Battle received compound fractures were all compounded from without in and were potentially septic because of the usually present extensive soft part and bone damage, the mud clothing and other foreign material often buried deep in the wound and the prolonged time lag from wounding to surgery. The wounds and incisions of initial surgery of necessity remained unsutured and reduction of the fractures was usually delayed 5 to 10 days until the wounded men had been transferred to base hospitals. The comparable lesions in civilian life, then are injuries many hours or days old

with unreduced fractures and open and possibly grossly septic wounds.

In the early experience, The Orr Trueta regimen of closed plaster subsequent to débridement had in general left much to be desired. Slow wound healing by granulation with heavy scar formation was accepted. prolonged wound suppuration with necrosis of living tissue was not infrequent. inadequate reduction of fractures anticipating malunion or nonunion was often accepted and the prolonged plaster fixation predisposed to extreme muscle atrophy and fixation of joints. Fear of stirring up and establishing limb or life endangering sepsis including gas gangrene had prevented efforts at delayed wound closure, at delayed open reduction and internal fixation of unreduced fractures, and even at radical secondary débridement to combat sepsis, the therapy of which had included only prolonged drainage through the open wound. local and systemic sulfonamide in an effort to control the bacterial flora of the wound and immobilization.

Based upon previous experiences and observations, during the Cassino and Anzio impasse in early 1944 and the later offensive attendant to the Fall of Rome, the closed plaster—open wound—fear of surgery in a septic field concept was discarded in favor of that of repaira

From Department of Surgery Washington University.  
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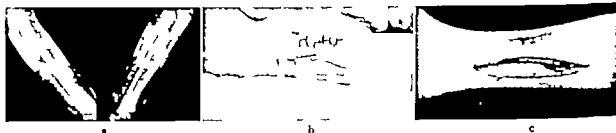


Fig. a, Anteroposterior and lateral views of comminuted fracture of the tibia at the junction of the middle and lower third, which had been produced by high explosive shell fragments with resulting gaping wound about 3 inches long. b, Eleven days after wounding and débridement, by means of relaxing incision about 6 inches long and

shifting of the flap, the compounding wound was sutured without tension. The defect created by the relaxing incision was at once covered by split graft. c, Twelve days later the compounding wound and the grafted defect were healed. Patient returned to duty status about 3 weeks after he had been wounded. (Courtesy J. B. Lippincott Co.)



Fig. 2 a Drawing of a huge wound compounding a fracture of the femur as it was observed ten days after wounding and initial surgery and another drawing showing the sutured wound, with dry fine mesh gauze as a drain to residual dead space. b Seventeen days later wound healing was complete and a dressing was no longer necessary. c,

Anteroposterior and lateral views of the fracture of the femur held in adequate although not anatomical reduction in double skeletal traction. Traction is being made on a wire through the tibial tubercle while vertical lift is being made on the distal femoral fragment by means of a second wire through this fragment.

tive surgery of compound fractures. The new regimen included aggressive secondary surgery in the several days old and possibly septic wound with delayed excision of dead tissue if necessary, internal fixation of fractures on precise indications and partial or complete closure of clinically clean compounding wounds with obliteration or dependent drainage of residual dead space. Penicillin therapy systemically was employed as a safe guard against invasive infection of living tissue by the bacterial flora of the open wound. It was used as a means to a better surgical result and not in an attempt to sterilize an open wound. Whole blood replacement therapy was used extensively to permit prolonged anesthesia and surgery as an aid in the prevention of chronic sepsis and presumably as an aid to wound healing.

The concept for the newer regimen may be stated as follows:

'Wound sepsis results from the septic decomposition of dead tissue including blood clot in dead space. If a wound is free of dead tissue and if dead space is obliterated or dependently drained and if living tissue is protected from invasive infection by an effective

antibacterial agent the bacterial flora of an open wound may be disregarded and any reparative procedure may be performed within the range of recognized surgical limitations without fear of sepsis and with the anticipation of good wound healing.'

The experiences and successes achieved in the application of this concept in the management of unreduced compound fractures with open wounds several days after the initial surgery permit the following conclusions. The supporting data, mostly have been published.

1. In the prevention or eradication of wound sepsis, regardless of the time lag since injury or duration of sepsis, the surgical excision of dead and devitalized tissue and the obliteration or dependent drainage of dead space are prime considerations. Devitalized tissue is the forerunner of sepsis and when sepsis intervenes, reparative measures are doomed to failure, delayed or nonunion of the fracture may follow and wound healing will be postponed or prevented. Hence the importance of thorough initial surgery in preparation for reparative surgery several days later.

2. Delayed closure of clinically clean wounds that is wounds free of dead tissue and débris

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OSCAR P HAMPTON Jr M D F.A.C.S St Louis, Missouri

THE advances during World War II in the management of compound fractures in their early phases came not only in improved techniques of excisional surgery in forward hospitals and in the broad application of specific procedures such as delayed closure of the compounding wounds and surgical incisions or delayed internal fixation of malaligned compound fractures several days later in base hospitals, but of greater importance, in a change of concept for the management of these wounds. Moreover the basic principles of the science of surgery itself were irrevocably reaffirmed.

Battle received compound fractures were all compounded from "without in" and were potentially septic because of the usually present extensive soft part and bone damage, the mud clothing and other foreign material often buried deep in the wound and the prolonged time-lag from wounding to surgery. The wounds and incisions of initial surgery of necessity remained unsutured and reduction of the fractures was usually delayed 5 to 10 days until the wounded men had been transferred to base hospitals. The comparable lesions in civilian life then are injuries many hours or days old

with unreduced fractures and open and possibly grossly septic wounds.

In the early experience The Orr Trueta regimen of closed plaster subsequent to débridement had in general left much to be desired. Slow wound healing by granulation with heavy scar formation was accepted prolonged wound suppuration with necrosis of living tissue was not infrequent inadequate reduction of fractures anticipating malunion or nonunion was often accepted and the prolonged plaster fixation predisposed to extreme muscle atrophy and fixation of joints. Fear of stirring up and establishing limb or life endangering sepsis including gas gangrene had prevented efforts at delayed wound closure, at delayed open reduction and internal fixation of unreduced fractures, and even at radical secondary débridement to combat sepsis, the therapy of which had included only prolonged drainage through the open wound local and systemic sulfonamide in an effort to control the bacterial flora of the wound and immobilization.

Based upon previous experiences and observations during the Cassino and Anzio impasse in early 1944 and the later offensive attendant to the Fall of Rome, the closed plaster—open wound—fear of surgery in a septic field concept was discarded in favor of that of repair

From Department of Surgery Washington University  
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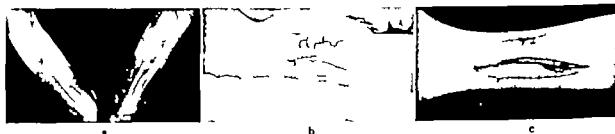


Fig. 1 a, Anteroposterior and lateral views of comminuted fracture of the tibia at the junction of the middle and lower third, which had been produced by high explosive shell fragments with resulting gaping wound about 3 inches long. b Eleven days after wounding and débridement, by means of relaxing incision about 6 inches long and

shifting of the flap, the compounding wound was sutured without tension. The defect created by the relaxing incision was twice covered by split graft. c, Five days later the compounding wound and the grafted defect were healed. Patient returned to duty status about 6 weeks after he had been wounded. (Courtesy J. B. Lippincott Co.)

judicious application of these principles that is, the excision of dead tissue when and wherever it is found obliteration or dependent drainage of dead space staged closure of wounds, atraumatic technique with fine hemostats and fine ligatures pressure dressings adequate reduction and immobilization of fractures, and precise splinting and with the

adjuvant use of penicillin and whole blood the objectives of the regimen were achieved Surely the same regimen under the same principles is applicable to many compound fractures of civilian life which are seen many hours days or weeks after injury has occurred and particularly to those with established sepsis

## OSTEOMYELITIS FOLLOWING COMPOUND FRACTURES

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THE changes which have been brought about in civilian practice with respect to osteomyelitis complicating compound fractures have resulted from the application of sound surgical principles and careful attention to detail. Many believe that the advances made in the treatment of these cases are the result of sulfonamides and penicillin. This is not wholly true for while the antibiotics have played an important part good surgical care has been of paramount importance. Antibiotics are best applied systematically and there can be no doubt that a patient in poor general condition does not respond as well to these agents in combating infection as one in a good state of health. In patients who have had acute blood loss or with hemoglobin values low because of long continued infection, it is necessary to give adequate blood transfusions if antibiotics are to be of value.

A debilitated patient is a good host for bacteria. A healthy one resists invasion by organisms. Compound fractures are severe open wounds. The fundamental principles underlying open wounds apply whether the bone is involved or not. The realization and adoption of these principles have resulted from experiences in World War II. Wounds seen early carefully cleansed of as many contaminating organisms and foreign bodies as is possible and

the devitalized tissue carefully debrided are best closed primarily. If this seems not feasible secondary closure (1) of the wound after several days is advisable. If large defects in the skin or soft tissue result immediate skin grafts assist the wound to heal kindly even though they may need replacing later with a full thickness sliding or pedicle graft. Obviously good principles of fracture and wound care must include immobilization. This can and should when possible, be accomplished without the use of screws or plates. Large dead spaces must be obliterated (3) and when this is not possible dependent drainage must be afforded to minimize the complication of osteomyelitis.

Chronic osteomyelitis resulting from compound fracture actually is less frequent today than it was before the war because these principles mentioned above have been more widely recognized as a result of the experiences of World War II. The best treatment for this condition is prevention and careful attention to principles of care of wounds. This is the best prophylaxis we have.

Chronic osteomyelitis should not be confused with hematogenous osteomyelitis which presents an entirely different problem. The two conditions are separate entities and have different clinical pathological radiological and surgical considerations. Unlike hematogenous osteomyelitis this type practically never metastasizes but remains an infection within the bone locally. The treatment of es



Fig. 3 a, Anteroposterior and lateral view of a compound fracture of the femur which is the site of a gas abscess. The patient had been wounded by a high explosive shell fragment 10 days previously and had received inadequate excisional surgery. Local and systemic sepsis had followed. Although the gas abscess is visible on the roentgenogram, there were no clinical signs of gas gangrene. b, The gas abscess was drained and devitalized tissue as excised through a long posterolateral incision. The dead space about the fracture site was obliterated by fixing the fragments in apposition by means of a six hole bone plate. This illustration shows the fracture partially united 3

months after drainage of the abscess and concurrent plating of the fracture. The wound had been healed since about 3 weeks after the internal fixation of the fracture. c, The wound remained healed and the fracture firmly united in anatomical alignment. Because of some absorption about the screw as visualized on roentgenograms, the plate and screws were prophylactically removed with immediate closure of the wound and primary healing. d, This illustration reveals the completely healed wound of the thigh (with some excess) e, scar formation which required later excision and subsequent repair. This end result is a triumph for the principles of reparative surgery.

and of signs of invasive infection is surgically sound provided dead space is obliterated or dependently drained and excessive tension is avoided. The sliding or advancement of flaps to permit closure without tension is often worthwhile. Therefore given a clinically clean compounding wound several days after excisional surgery wound healing by granulation should be scorned and if surgical limitations do not preclude, wound closure by suture or skin graft should be performed. Wound healing while affected by several factors, is a natural cellular growth provided the wound does not contain dead tissue dead space strangulating ligatures, etc. Wound closure may be practiced to the extent to which these qualifying factors can be surgically obliterated.

3 The best evidence of adequate excisional surgery is a clinically clean wound 5 days later the optimum time for delayed wound closure. Within this period excellent drainage of wound exudate and residual debris is provided, and closure of wounds before the formation of heavy granulation tissue and reduction of fractures before the fixation of fragment ends are permitted.

4 Despite an unhealed wound inadequate reduction of fractures need not be accepted if it is preventable by open reduction with or without internal fixation. Reduction of the fracture eliminates the dead space about malaligned fragment ends, avoids subsequent manipulations which may produce additional devitalized tissue and anticipates minimum deformity. Internal fixation is detrimental to wound healing only as devitalized tissue is created in its application or as it interferes with soft part coverage of denuded bone.

5 The regimen as a whole may be expected to achieve minimum sepsis rapid healing of wounds with minimum scar maximum reduction of fractures, and maximum functional restoration of the extremity. In this experience no loss of limb or life attributable to the aggressive surgery was reported.

In summary reparative surgery of compound fractures represented a major advance in World War II. Under its principles, the spotlight was moved from the bacterial flora to the pathology of the open wound and a surgical approach was established for the management of septic compound fractures. By

# APPLIED ANATOMY IN EYE SURGERY

MEYER WIENER, M.D. F.A.C.S. Coronado California

**A**PPLIED anatomy serves a twofold purpose. It gives a precise basis to those occurrences and procedures that especially involve anatomical knowledge, and, in addition, it converts an otherwise unusually dull subject into one of interest by associating it with something manifestly useful and practical.

The student of anatomy has a somewhat hazy fanciful notion that his study of anatomical structure will, in some way and at some future time prove useful to him. By incorporating with it its surgical application he is made aware of its value in very much the same way as a series of experiments in laboratory physics relates to sheer theoretical, scientific data.

While it is assumed that eye surgeons, in general, are acquainted with most of the premises which I am presenting it is with the hope that the memory of the dissecting days which have been growing a bit gray with some of us will wish to recall some of the anatomical matters which have the most direct bearing on surgical practice.

In surgery of the lids we must constantly bear in mind the delicate nature of the skin as well as the changes which come with advancing years which have a direct connection with surgical performance. The skin of the eyelid is the most delicate in the body pale and loosely attached. The foreskin approaches it most nearly in texture. However, it is not wise to use foreskin for lid replacement because, for some unknown reason, it nearly always becomes deeply pigmented. If not much is needed, the skin of the opposite lid is ideal if available. Probably next in order is that just back of the ear or that from the inside of the arm.

In old age the skin atrophies and loses its elasticity due to atrophy of the elastic fibers. This sometimes induces spastic entropion since the overaction of the orbicularis has no

resilient skin to overcome it. The Ziegler cautery is effective by causing the skin corresponding to the lower margin of the tarsus to adhere to this border so that it will not curl up and roll over the lid margin. In like manner, cauterization of the conjunctival side in hypertrophic ectropion probably causes the conjunctiva to attach itself to the inner border of the tarsal plate. Sometimes in advanced age there will be considerable tearing with a patent drainage canal, often due to lax skin plus a hypertrophy of the conjunctiva. Making only a few punctures immediately inside the canaliculus will bring in the lid margin just enough so that the lower punctum will contact the globe and again siphon off the tears.

It is well to contemplate the width of the tarsal plate in selecting the type of operation for correction of contractile entropion. The tarsus of the lower lid is much narrower than that of the upper. The width of the normal upper being about 10 millimeters and that of the lower about 5 millimeters. Hence in surgical correction of the upper lid, where the tarsus is still wide we may attach the cut edge of the skin near the lid margin to the top of the cleaned tarsus and have a right to expect a satisfactory result. This may be further improved by removing the thickened orbicularis attached to the tarsal plate, producing a wider palpebral fissure. The lower tarsal plate is seldom wide enough to justify utilizing this method so the modified Green Ewing method is recommended, as this does not require a wide tarsus.

The eyebrow is thick and curved so as to protect the eye from sweat and blows. It also helps shade the eye from excessive light by bending over. It should not be plucked and if destroyed by injury should be restored for thus and cosmetic reasons. The lashes serve the same purpose and need not be trimmed before surgery. It is often a great advantage to grasp the lashes after operation to pull the lid away from the eye in closing it. The lashes can be replaced by a narrow graft from the

tablished osteomyelitis following a compound fracture is a problem in the care of the local area supported by systemic treatment to aid in combating the infection and supporting the patient constitutionally. Open drainage with removal of infected areas by saucerization permits drainage after the infection has become localized. This is a principle similar to the treatment of localized infection of other parts. A lesson which has been learned from World War II is that large open defects must not be allowed to remain to depress the vitality of the patient. Skin grafts should be applied as soon as clean granulations have covered the drained area to minimize loss of fluid and discomfort to the patient. These should be applied early even though they are not sufficient in themselves to give good permanent coverage to the area. When such wounds have been properly covered the patient is more comfortable and early reconstructive surgery can be accomplished with the aid of antibiotics.

Prior to World War II it was considered poor surgical judgment to attempt reconstructive surgery in the area where infection had taken place because of the possibility of reactivating the infection. On one of the large orthopedic services (2) of a general hospital in the Zone of the Interior 90 per cent of the procedures were done through the original incisions with approximately 5 per cent flare up of infections. Bone grafting to fill defects was also performed 6 to 8 weeks after wound healing. This has been made possible by general supportive measures and the use of sulfonamides and penicillin systemically. The value of appropriate chemotherapy before and after operation in the care of osteomyelitis cannot be stressed too strongly and prolonged administration is of definite value (5).

Reconstructive surgery of the skeletal system should not be done in the presence of draining sinuses, open draining wounds, or any clinical evidence of wound infection. This concept is no different than it was before the

war. Penicillin or sulfonamides cannot be expected to be of value in the presence of undrained abscesses, the presence of sequestra, detached fragments of bone with aseptic necrosis or any other foreign body.

Frequently large open wounds with considerable loss of skin muscles, tendons, nerves, or blood vessels with bone trauma may be diagnosed as osteomyelitis incorrectly because of the constant drainage or "weeping" from granulation tissue (4). In such cases the drainage will usually stop when the wound is closed by a skin graft if osteomyelitis is not present.

The differences in the care of compound fractures in World War II as compared with World War I are striking. In compound gunshot wounds during the first year of World War I the total mortality was reported to be about 60 per cent (6). With emergency splinting on the battlefield the mortality was reported to be about 12 per cent at the end of the third year. During and following World War I compound fracture wounds were debrided and packed open with vaseline gauze with immobilization by plaster. This continued as the accepted form of treatment even during the late Spanish Civil War (7).

The present concept in the treatment of compound fractures which has resulted from World War II has decreased the morbidity and the incidence of chronic osteomyelitis. The application of the principles usually accepted for other infected wounds, as well as the use of chemotherapy has improved the results in cases of chronic osteomyelitis.

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resilient skin to overcome it. The Ziegler cautery is effective by causing the skin corresponding to the lower margin of the tarsus to adhere to this border so that it will not curl up and roll over the lid margin. In like manner, cauterization of the conjunctival side in hypertrophic ectropion probably causes the conjunctiva to attach itself to the inner border of the tarsal plate. Sometimes in advanced age there will be considerable tearing with a patent drainage canal, often due to lax skin plus a hypertrophy of the conjunctiva. Making only a few punctures immediately inside the canaliculus will bring in the lid margin just enough so that the lower punctum will contact the globe and again siphon off the tears.

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brow or from the hair line back of the ear. Recently Goldzieher reported some preliminary experiments he made on the skin of three elderly women after some previous experiments on dogs. He applied two estrogenic substances, estradiol and stilbestrol daily to the inner areas of the arms and thighs for a period of 6 weeks. Small sections of the skin taken from these areas showed restoration of the width of the epidermis, the number of cell layers increased, the individual cells larger and the elastic fibers more numerous.

I have seen the skin of the upper lid so lax that it drooped down and cut off some of the temporal field. For this reason as well as for appearance sake, a strip of it was removed.

The levator palpebrae is inserted in the skin of the upper lid the lower third of the tarsus and along with Mueller's muscle to the upper edge of the tarsus. It is mainly these latter fibers with the attached aponeurosis that we use in Canthas operation, where the paralyzed levator is attached to the tendon of the superior rectus.

The lymph channels from the upper lid pass through the preauricular node those of the lower lid, the submaxillary node (Treves). This is important in differentiating the lead of drainage in infections and sometimes helps in locating orbital infections where the septum orbitale has been penetrated.

Paralysis of the sixth nerve is particularly associated with fractures of the base of the skull, owing to its long course beneath the dura and its close confinement beneath the petrosphenoidal ligament. In fact, it was Pannas who first recognized that a fracture of the base of the skull might be manifested by a paralysis of the sixth nerve alone. Creptus of the lids usually denotes fracture of the nasal bone, although fracture of any of the bones forming the nasal sinus cavities connected with the orbit may give rise to air in the orbit or lids.

The orbital cavity is about half an inch wider in the horizontal than in the vertical direction. Therefore it will be seen that there would be more space between the eye and the orbital wall on the sides than above or below and the greatest interval between the globe and the orbital wall is on the temporal side.

For this reason, growths which start on or at the apex of the orbit, or even on the opposite side may soon find their way to the temporal side of the orbit. Dermoid cysts of the orbit are almost invariably found on the outer side, and although they may appear small, on operation will be found to extend to and be attached very close to the apex of the orbit. It is possible that the orbital septum keeps them within bounds and from protruding forward to any extent.

An intraorbital growth which is not within the intramuscular cone and presents on the temporal side can be reached better through a conjunctival incision than by one through the skin. Sometimes, even with the assistance of x rays, it is not possible to tell whether the growth is beneath or above the periorbita and exploration only will determine that fact. If the bone of the periorbita is involved then access through a skin incision is best. To reach growths in the intramuscular cone a Kroenlein approach seems best. In performing this operation, guard against severing the external rectus too far back or a paralysis may result. If the tendon is cut instead of the muscle belly it can be sewed together without fear of this happening. In performing visceration of the orbital contents, it is done easily and quickly by separating the periorbita from its attachment to the wall of the orbit and then continuing to loosen it with a periosteal elevator back to the apex then cutting off the entire mass from its apical attachment. A clean orbital wall is thus secured and with a minimal amount of bleeding. The cavity must be kept packed sufficiently tight to keep the lids on a stretch, which will otherwise shrivel and atrophy. Of course, if one does not expect to preserve the lids and eventually fill up the orbital cavity then the lid margins may be freshened, sewed together and utilized to serve as a covering for the denuded orbital wall.

The conjunctiva is very loosely attached to the globe in man. The reverse of this is noted in operating on animals eyes even in monkeys. Man having a smaller cornea in proportion to the size of the globe than any other animal, necessarily has more of his sclera, covered with conjunctiva, exposed than any other creature. The negro, having a larger eye than

the caucasian, makes this still more noticeable. This makes it easier to perform surgery on man than on animals, as anyone who has experimented on animals' eyes will have observed. There are other reasons also. This looseness of the conjunctiva is of value in eye surgery in several ways, such as making conjunctival flaps to cover the cornea correcting mild cases of symblepharon and in other plastic procedures. The distance of the conjunctival fornix from the upper lid margin is from 20 millimeters to 25 millimeters. The tarsal plate is from 10 millimeters to 12 millimeters wide. The distance of the fornix to the corneal margin is 8 millimeters to 10 millimeters. Hence, we have a loose surface of conjunctiva 18 millimeters to 22 millimeters wide from which we may easily take half or three quarters for use of a conjunctival transplant on the other eye socket, or for use in restoring the lining of the canaliculus in a plastic operation for restoring its lumen.

Pterygium is described as a conjunctival growth extending over the cornea. At any rate, the underlying cornea is always involved with destruction of Bowman's membrane not only immediately beneath the pterygium but according to Fuchs, to a point about 3 millimeters beyond the apparent apex. In my experience recurrences can be almost invariably prevented if one includes this involved corneal area in his dissection and resects a few layers of the cornea proper beneath the destroyed Bowman's in dissecting off the pterygium.

The most common tumor of the conjunctiva is the naevus. Many are not pigmented and few of them are malignant. About 10 per cent of the tumors are dermoids and in their removal one must bear in mind that the underlying sclera may be very thin.

While ballooning out the retrotarsal fold with 2 per cent procaine to which a drop or two of epinephrine has been added will completely anesthetize both surfaces of the lids for practically all operations on the lids proper so that no pain will be experienced when the tear drainage apparatus is involved, more than that is required. For the lids all of the terminal nerve endings are thus caught supplying the entire thickness of the lids. In order to anesthetize the canaliculus and sac so

that no pain will be felt by the patient to catch all of the nerves supplying the canaliculus one must first instill a drop of pontocaine then insert a small wad of cotton soaked with pontocaine and epinephrine in the inner canthus and after waiting about a minute insert a fine hypodermic needle into the conjunctiva just behind the punctum and slightly temporarily to it, inject a drop or two of the solution of 2 per cent procaine the needle is then advanced in the loose tissue along the course of the canaliculus and drop by drop injected additionally as it is pushed toward the sac. When it reaches the periosteum covering the sac wall a sharp momentary pain is felt until a drop is injected here. Here, the periosteum is very sensitive as the main branches of the supratrochlear and infratrochlear nerves are encountered. One may now pass the dilator and probe into the canaliculus and down through the sac without the patient experiencing any pain. This, together with the anesthetization of the nasal mucosa by the otolaryngologist is sufficient for the intranasal dacryocystorhinostomy.

In doing an extranasal operation or in removal of the sac, one must block the supratrochlear and infratrochlear and the infraorbital. In passing a probe down the nasal duct one is much more apt to make a false passage with a small probe than with a large one. The lumen of the sac is not just a smooth tube, but is often sacculated in such a manner that the small probe will pass into one of these pockets and penetrate the lining whereas a larger one might spread the lumen so as to obliterate the defect temporarily and go right on through. Pictures of these anatomical variations illustrated in both Whitnall and Schaeffer should impress this fact on our minds with impelling force.

One of the most frequent sources of failure in performing any type of intranasal tear sac operation is the failure of the surgeon to make his opening through the bone and sac inside the nose low enough so that the fluid will drain into the nose and not leave a pocket below the opening holding pus. Another of course, is failure to keep the opening patent. It is essential that the puncta be in contact with the globe and that the canalicula not be slit, in

order to have complete drainage. The canaliculae are also shortened by blinking making them wider and thus helping to carry off the tears. In old age when laxity of the skin sometimes causes the puncta to drop away from the globe, relief can be had by a limited Ziegler cauterization.

In operations on the cornea it is well to recall that normally it is thinnest at the center where it averages about 0.8 millimeter widening at the periphery to about 1.2 millimeters. It gets thinner with advancing years and may be less than 0.5 millimeter at the center in the aged. This, plus the loss of resiliency accounts for the sinking in or collapse of the cornea in very old people after cataract incision. A bubble of air injected into the chamber will maintain the normal curvature of the cornea until it has healed.

While Bowman's membrane, if destroyed never regenerates, it is not an essential part of the cornea for either visual or protective purposes. One may resect a corneal scar and obtain clear vision in its absence with apparently no more hazard to infection in its absence than if it were present. In resecting the cornea for corneal scar or peeling it off it is well to bear in mind several things. First, the formation of connective tissue producing the scar creates a much thicker protective shell than the normal cornea. This means that the cut, in preparation for peeling, must be deeper than one would make in a normal cornea, in order to get below the scar formation. Most eye surgeons fall in their corneal resections by not keeping this fact in mind. It also requires more pressure with the knife. It is also less flexible than the normal cornea and cannot be pulled back too much without endangering perforation of the thin underlying transparent cornea. Second in making the crucial incision with the scalpel don't forget that you are not cutting on a flat surface, but over a convexity with a radius of about 80 millimeters. Hence, the handle of the knife must be raised in starting the incision at the limbus and gradually lowered as the cut proceeds toward the opposite margin so as to keep the cutting edge, and not the point of the knife, in contact with and conforming with the corneal curve. This enables one to make his primary

cut much deeper without the danger of perforation. Third, and no less important an anatomical point to bear in mind is that the lamellae, normally about 60 in number and from 1.3 microns to 2.5 microns thick, run the entire width of the cornea, crisscrossing with each other at right angles and with very little interlacing so that they run almost parallel to the curved surface. When one picks up a single section to be peeled off it is essential that he stay in the same layer as that in which he started otherwise whenever he cuts across the intervening layers, connective tissue will form with resulting scar. By following proper technique, closely watching the line of cleavage, this is not difficult to do.

In an article by Edward Jackson on "The Function and Structure of the Eye," he stressed the fact that transparency depends on permeability to some substances of the transparent membranes, which included Bowman's and Descemet's in the cornea, capsule of the lens, Bruch's membrane of the choroid, and their impermeability to others. Rupture brings about loss of transparency. The cornea may lose its transparency from transudate or edema, as in glaucoma exudate, as in keratitis blood staining from blood in anterior chamber becoming hemolyzed scar tissue for maturation and dissolving of the cement substances between the lamellae in the stroma so that the refraction index is interfered with. This latter is probably due to infiltration of aqueous, such as that due to rupture of Descemet's from birth injury. Edema due to entrance of fluid through the epithellum can be differentiated and temporarily cleared by the glycerine test suggested by Cogan. Jackson lays continuous stress on the resilience of the cornea and refers to Salzman's description of the arrangement of the layers, because it is more important and easier to understand when considered as a provision for resilience. Hence, no compression bandage after a corneal cut or cataract operation and keeping the wound elevated. He quotes Ellett, speaking of sutures in cataract operation "I think it does give a relative assurance against prolapse, but then there is still enough trouble from this source to lead me, after a rather extensive trial of the simple operation to give up

in favor of the combined operation, except in such cases where the cosmetic effect was a thing to be considered.' Jackson used no corneal suture relying upon the resiliency of the cornea.

The elasticity of the cornea is greater in the vertical than in the horizontal direction which may account for the astigmatism in glaucoma according to Schreder who found it to be anisotropic that is exhibits different properties when tested in different directions.

The cornea is about 12 millimeters in diameter, but the sclera extends 1 millimeter over the edge in the horizontal and 2 millimeters in the vertical meridian. In some cases it extends 3 millimeters or even 4 millimeters over the edge in the vertical meridian especially so in glaucoma cases. This is a fortunate arrangement in shelving the cornea. This broad limbus is marked in hydrophthalmus too.

The epithelium around the limbus is potentially a pigment bearing tissue this can especially be noted in animals one may therefore get a pigmented papilloma at the limbus with out its being a melanoma.

The sclerocorneal junction is the weakest part of the eyeball. Rupture of the globe at this point may find the lens under the conjunctiva. If the lamina papyracea, which forms the inner wall of the orbit, should rupture then the eyeball will not rupture. One or the other may rupture, but never both. Decemet's membrane may rupture in birth injuries or in keratoconus and lead to permanent clouding of the cornea, probably through absorption of the interlining cement substance of the layers. Decemet's membrane is easily detached, as happens in doing a trephine or cyclodialysis. It curls under certain conditions and is very elastic. Unlike Bowman's it rapidly regenerates. It is really a crust formation laid down by the endothelium lining the inside of the cornea. This is contrary to the opinion of Elliott, who stated that it and the endothelial lining never regenerated and recommended denuding the endothelium just beyond the limits of the trephine opening so that the opening would not fill up.

At the periphery of Decemet's membrane in most people lies the anterior marginal ring as a circular band. It may go only part way

around and be rudimentary and can be seen with the gonioscope. Decemet's membrane is more resistant, both to the trephine and to infection than is the stroma. One may find 'warts (cornea guttata) around the periphery of Decemet's, which can be seen with the slit lamp and sometimes with the gonioscope. So long as they remain in the periphery they are of no special significance but if located in the center of the cornea the vision may be reduced as much as down to 20/40 or 20/70, and this must be kept in mind in cases of otherwise unexplainable reduced vision. They sometimes permit the aqueous to leak into the cornea.

There are a number of things which make knowledge of the scleral structure a matter for serious consideration in eye surgery. The sclera is about 0.6 millimeter thick at the limbus. Just back of the insertion of the muscles it is thinnest — 0.3 millimeter or less. This is where the sutures for recession are placed, and fortunately need not, and should not be deep. Going back to the equator it thickens to 0.6 millimeter and increases to 1.0 millimeter in the back. At the point of entrance of the optic nerve it is very thin owing to the perforations of the lamina cribrosa. On account of this inequality of the thickness one can easily see the futility of using pins in operating for retinal detachment for, if the pins are set for the proper depth in the thin area, they will not be deep enough where the sclera is thickest. The reverse is also true. The zone overlying the ciliary body is a circular area concentric to the limbus 5 to 6 millimeters back. The equator is 13 to 14 millimeters back of the limbus. The area of the venae vorticosae is represented by a concentric band 3 millimeters wide and 18 to 21 millimeters back of the limbus, or 5 to 8 millimeters back of the equator. The superior temporal vena vorticiosa lies 7 millimeters back of the equator, the superior nasal 7 to 8 millimeters the inferior temporal 5 millimeters and the inferior nasal 6 millimeters. These exits can be seen and in operations for detached retina and posterior sclerotomy these positions must be kept in mind. In posterior sclerotomy it is best to keep near the equator to avoid these and the long ciliary vessels.

Calcification of the sclera is very common in old age and follows absorption of the elastic

fibers in the sclera. This tends to give one the impression of increased intraocular tension by the finger test which is not borne out with the tonometric measurements. Again the point of the cataract knife may encounter one of these hard particles and interfere with making a satisfactory section. They are usually found on the nasal side as grayish depressions, about 4 millimeters back but exceptionally may appear further forward near the margin. If this process is far advanced the eye loses its power to adjust itself to lessened volume, as when the chamber is opened and the lens removed this can be made up by injecting air into the chamber. This factor may account for choroidal detachment, according to Fuchs.

The emissary perforations in the sclera lie 4 to 6 millimeters back of the limbus and are of great importance. Sometimes the long ciliary nerves loop up and look like small, gray tumors in this region. These have been excised under this delusion which is followed by anesthesia of the corresponding width of the cornea. They can be easily differentiated after having first anesthetized the eye by grasping the mass which induces severe pain. Old glaucoma can often be suspected by the enlargement of the ciliary arteries emerging suddenly from these openings, giving the impression of being more greatly enlarged than they really are. New growths of the ciliary body often emerge from the emissaries and give the impression that they are autonomous, localized ones. Transillumination and other means will determine such.

The sclera is loosely attached to the choroid except where the vessels and nerves penetrate it. In making an incision for cyclodialysis, a sharp corneal hook picks up the sclera, making it very easy to cut through the sclera without touching the choroid, since traction with the hook pulls the sclera away from the choroid. Be sure to make the cut in a place free from vessels which is not hard.

In performing posterior sclerotomy for glaucoma, it is essential to use a knife just as sharp as one would wish for in making a cataract incision and thrust it quickly through into the vitreous with the blade parallel to the antero-posterior fibers so as not to separate the retina from the choroid. As the blade is withdrawn

the incision is enlarged toward the posterior pole. There is a definite place for this little used operation one of which is in cases in which after a drainage operation the iris or ciliary body has come forward into the wound following an apparently successful operation, causing the tension to rise again. The release of the pressure behind the lens will often cause the ciliary hernia to recede and remain back. There need be little or no bleeding if the technique is carried out properly. This admonition must also be heeded in making the incision for the removal of foreign bodies by the posterior route. In this case the incision must be fully 50 per cent larger than the largest diameter of the foreign body for one never knows which end is coming first and it may even come broadside. A long incision heals just as quickly as a small one and does not invite danger of retinal detachment, in my experience, even though one fails to perform electrocoagulation as a preventative measure.

The capsule of Tenon is both membranous and elastic. It is more or less adherent at the attachment of the muscle tendons and in some places to the fat of the orbit. Semeraro found that in tests carried out on the cadaver Tenon's capsule is nonexistent in some cases. This fact may account for the slipping out of the capsule of the implant in many cases of enucleation where the operation seemed to have been well carried out. We have never encountered this condition in the living eye in the many operations involving the muscles, although it does seem to be much less developed in some cases than in others. There is no actual space between the ocular surface of the capsule and the orbital surface opposing it, but the two are connected by a felting of very fine strands of connective tissue. These are loose enough to permit the eyeball to move freely in a limited way but in extreme excursions both globe and capsule move together as a whole in a bed of orbital fat, which is loosely connected to the capsule behind. There is a difference of opinion as to how far forward the capsule extends. Sobotta states that it terminates at the upper retrolaral fold and at the insertion of the muscles. Most authorities agree that it blends with the conjunctiva as far forward as the corneal margin

Where the vessel sheaths blend with the capsule, they give offshoots to the orbital walls known as the check ligaments. We shall speak of these in a moment. The septum orbitale is a thin membrane of connective tissue which extends from the entire orbital margin toward the palpebral opening and tends to hold infections to either the orbit or to the anterior part of the globe. The capsule of Tenon as well as the periorbita and the sheath of the optic nerve, are continuous with the dura. For this reason it is dangerous to perform enucleation in panophthalmitis with marked cellulitis of the orbit, as it may lead to meningitis and subsequent death of the patient. I saw this happen once while I was a medical student. Evisceration is here indicated. In removing the contents of the globe it is imperative that no remnant of the uveal tract remain. The choroid is firmly attached in two places posteriorly, where the posterior ciliary vessels and nerves enter and in front where the anterior vessels and nerves pass through the emissaries. These points must be most carefully inspected on conclusion of the operation. When all of the pigmented material has been removed, the sclera will be seen as a white smooth surface and there will be no bleeding. If the usual enucleation is done and a glass ball is inserted it is well to figure out just how large the cavity is so that too large a one will not be introduced and be expelled. If we could count on preserving every bit of capsule as far forward as the attachment of the muscle tendons and not allow any for the depth of the sutures, then we might easily put in a 14 millimeter or even a 15 millimeter implant in the capsule. However, anteriorly the capsule is so intimately connected with the sclera that it isn't detached for several millimeters back of the insertion. Therefore, if one inserts a small ball, not over 12 millimeters in diameter there will be less stretching of the capsule in sewing it in and more likelihood of it not being expelled. This rule holds good, also for implanting after evisceration for the reason that taking off all of the cornea and part of the sclera lessens the diameter of what remains. It would seem that Burch's recommendation of leaving the cornea intact and implanting a larger sphere should give a far better result.

In a clean enucleation it is not necessary to sew the tendons together for they are closely attached to the capsule and fall naturally together whether the capsule be sewed or not. In enucleating a globe for absolute glaucoma where we have a very deep cup, if the nerve is cut too closely one is apt to lose vitreous for there is no vitreous hyaloid membrane either over the nerve head or the ora serrata. Women's eyes are larger than men's and the negro eye is larger than that of the white man hence, a slightly larger implant can be used.

In man, the conjunctiva is very loosely attached to the globe except at the limbus. It stretches readily. The capsule of Tenon is supposed to run forward beyond the attachment of the muscle tendons to blend with the conjunctiva. For all practical purposes one can almost forget it is there, unless it constitutes the deep layer under the loose, conjunctival connective tissue which hugs the sclera. In making a flap for sclerocorneal trephine, one must hug the scleral surface closely with the blunt scissors in order to obtain a thick, protective flap. At the point where the sclera and cornea join, the knife is substituted and the cornea split. One can easily determine when the cornea has been reached by its bluish appearance. The same technique for splitting the cornea in a sclerocorneal trephine is recommended as in the resection for corneal scar. If properly done it requires less than a minute's time.

In exposing the muscle tendons for advancement recession or enucleation the capsule of Tenon should be disturbed as little as possible and none of it lost. Make the incision in the conjunctiva large enough for freedom of operation for a large incision heals just as easily and quickly as a small one. When the area to be explored is sufficiently exposed remember that immediately under the conjunctiva and over the capsule is some loose connective tissue which will be grasped by the forceps instead of the capsule if it is not pushed aside. To accomplish this place the flat fixation forceps so that the blades will be closed and parallel to the length of the tendon press it down on the globe and at the same time, separating the blades while still maintaining the pressure. It is necessary that the forceps have

a strong spring in order to do this properly. Then, without releasing the pressure, separate the blades about 2 or 3 millimeters and then make increased pressure against the sclera so as to indent it while closing the blades. The forceps will now have a good hold on Tenon's. Keep the grasp firmly make a snip with the scissors close to the end of the forceps while pulling it slightly away from the sclera keep the original grasp on the capsule until the hook has been slid under the tendon. The reason the blades must be kept parallel to the length of the tendon is that when the eye is rotated to expose the area, the capsule, as well as the tendon is put on a stretch which makes it easy to be grasped thus and very difficult if it is attempted against the stretched tissue.

The average distance for the attachment of the recti muscle tendons back of the limbus is, medial 5.5 millimeters inferior 6.5 millimeters lateral 6.9 millimeters superior 7.7 millimeters. Hence, the forceps must be placed far enough back to catch the free side of the tendon. Of course, these measurements vary considerably and, according to Motais they may be as far back as 7 millimeters for the medial and 11 millimeters for the superior. It is better to allow for the maximum than to get too far forward. It is also well to bear in mind the width of these tendons so that in first placing our forceps in position we will not include any of the tendon fibers. The average breadth of the tendon varies from 9.2 millimeters for the lateral to 10.75 millimeters for the superior. Thus one sees that in placing the forceps it is well to be about 6 to 7 millimeters beyond the estimated center of the tendon to be exposed. While the medial rectus is thickest and strongest, its tendon is also the shortest, averaging less than 4 millimeters in length while the lateral, which is the weakest, is nearly 9 millimeters long. It also must be noted that the lines of insertion of the tendons are not straight, but are curved, or even wavy and do not lie parallel to the corneal margin. For example, it is easier to approach the tendon of the superior rectus from the medial side than from the temporal since it is several millimeters closer to the limbus nasally.

The superior oblique attachment to the globe lies just behind that of the superior rec-

tus. Therefore, all one has to do to expose the superior oblique tendon is to engage the attachment of the superior rectus tendon with the hook, reverse the pull by turning the hook and draw the hook backward, thus engaging the tendon of the superior oblique and pulling it forward into the conjunctival wound.

Since the inferior oblique arises from a small depression on the orbital floor just within the inferior orbital margin lateral and close to the nasolachrymal canal, it can be easily exposed by a deep incision into the lower conjunctival sulcus deep enough to strike the periosteum on the floor of the orbit, introduce the hook into the opening until it strikes the floor and then sweeping it nasally until the resistance of the attachment is felt whereupon it is drawn into the wound.

Stitches for a recession are placed where the sclera is thinnest. Fortunately the stitches in this case need not be and should not be as deep as for advancement, for there is less pull on the muscle operated upon after than before the operation for two reasons. First, because the tendon is set farther back, and because the muscle is partly paralyzed from handling. If all of these rules are followed out, bearing in mind the anatomical features mentioned, the tendon of any of the muscles, either straight or oblique can be caught with the first sweep of the hook. Failure to do so means faulty technique.

The attachments of the capsule of Tenon to the margins of the orbit prevent the muscles from entirely retracting and, even when the globe has been removed give them bases to act upon, thus preserving some motility in the stump. Rough handling of these attachments so as to mutilate these parts of the capsule can result in an ugly proptosis after a strabismus operation or sinking of the globe after enucleation. When a part of the capsule known as the suspensory ligament of Lockwood is mangled the eyeball drops or there may be excessive lateral rotation of the globe or upward movement. Instruments should always be sharp so that clean cuts can be made with the scissors instead of tears. Clean cuts heal easier and are less prone to infection.

O Connor suggested a novel method of increasing the effect of the Himmelsheimer oper-

ation by utilizing the nasal third of the rectus muscles, turning them under the rectus tendons before sewing them laterally. The objection to this, however, is that it puts even a greater stretch on these transposed portions. A more secure method is suggested for this valuable conception utilizing the paralyzed, split rectus to attach to the vertical recti and then severing the nasal third of their attachment to the globe. This involves the same principle as the O'Connor method is easier to execute and eliminates the danger of tearing loose of the vertical strips.

In operating on the muscles in order to obtain complete anesthesia, it is necessary not only to instill an anesthetic in the conjunctival sac and inject the intramuscular cone but also to use a very fine needle and inject a drop or two into the muscle belly itself. While most of the sensory nerve endings terminate near the tendinous attachment, the tendon tissue is too dense for it to spread and complete absence of pain will be accomplished only by injecting into the muscle itself.

In a recent article on "Guides to Choice of Operation for Squint" Sugar stressed Biel schowsky's guide to choice of operation based on anatomical and physiological principles. They are important enough to repeat here:

1 When a difference in the two eyes under cover can be determined, the eye showing the smaller deviation is the paralyzed one.

2 When the vertical deviation of the paralyzed eye is greater in adduction an oblique muscle is involved (because the obliques help in adduction) and for the same reason when it is greater in abduction a vertical muscle is involved.

3 The image of the paralyzed eye is always seen in the direction in which the affected muscle should move the eye.

4 When tilting of images is marked and tipping of the head greatly increases diplopia, an oblique muscle is nearly always involved.

5 The principal action of a muscle should always be considered.

Klein in investigations concerning the lens capsule and its importance in the technique of intracapsular cataract extraction emphasizes the fact that the zonular lamella is a very thin membrane that covers the peripheral parts of

the anterior lens capsule and is easily separated from it. The posterior capsule is thinner than the anterior lens capsule, the central area of each is thinnest, the maximum thickness being between the equator and the center. In old age the zonular fibers become fragile and the capsule thicker (there is an exception, that of the Morgagnian where both become thin). By a special method, he found that the capsule can resist a pressure of 150 to 200 millimeters of mercury. He recommended traction on the lens capsule and simultaneous pressure at the limbus with a hook to rupture the zonule then, repetition of the maneuver in a different direction. In intumescent and hypermature lenses, as well as in those cases where there has been a previous uveitis, the zonule is so weakened that it is ruptured with a minimum amount of pressure so that the lens can be extracted by the Smith method without touching the capsule. These are the only cases where the Smith method is recommended.

Since the lens capsule is thickest between the center and the periphery this is where it should be grasped with the Arruga or similar forceps in breaking the zonule. There is a tendency of many surgeons in order to make sure of securing a firm hold on the capsule, to take too wide a bite. When this is done it stretches the capsule to such an extent that it is more liable to break before the zonule ruptures. The zonular lamellae may extend back as far as the ora serrata and if pulled upon too much can detach the retina or pull a hole in it. This may occur in doing an intracapsular, or even in doing a needling if not done properly. The lamellae may not attach and there may actually be a thickened capsule around the edge of the lens which may desquamate into the anterior chamber and cause glaucoma.

The anterior hyaloid has tremendous stretching qualities and may come forward after the cataract incision and be mistaken for vitreous. If the speculum be immediately removed and traction made by pulling down on the upper lid, it usually retracts and one may proceed with the operation. Here is another advantage of having lashes with which to grasp the upper lid in order to pull it away from the globe. There may be an anomalous



union of the anterior hyaloid with the lens capsule which proves a detriment to extraction in the lens capsule for in this case the hyaloid is torn and vitreous exudes. This anomalous condition cannot be determined beforehand.

In the embryo there is a sinus running around the pupillary area and in adult eyes cysts sometimes form in this sinus area separating the pigment layer. They may manifest themselves by floating down in the pupillary area as a black mass when we may assume that it is a cyst. If however the black mass is seen at the base of the iris melanoma must be suspected.

Tags near the base of the iris show a reversal to the pectinate ligament in lower animals. Normally in the human there are only a few trabeculae in the angle. These may extend from a peripheral iris knob which at times is present in the human. If present in a glaucomatous eye the synechiae will run from it to the angle.

The vessels of the iris run parallel with the radiations. Hence cutting the iris in the direction of the fibers in an iridectomy causes less bleeding and, at the same time, enables one to make a deeper iridectomy. For this reason I fail to see how a peripheral iridectomy in acute glaucoma can be as effective as a complete one, as claimed by some.

Sugar stresses the importance of knowing the depth of the anterior chamber in glaucoma and describes a method for measuring it by means of the McNair Bettman portable slit lamp. The important thing is the angle. Of special significance is the condition of the angle, which can be determined by gonioscopy. Through this means Barkan has developed the operation of goniotomy for congenital glaucoma, which consists of removing occluded fetal meshwork from the angle promising much for this hitherto almost intractable disease. Anderson's analysis of 84 specimens,

finding the canal open in 75 per cent of the early specimens and no trace of it in children over 2½ years of age, none of which had been operated on strengthens Barkan's warning for early operation in these cases, since the distention of the eyeball tends to obliterate the canal. Barkan makes the distinction between goniotomy in the infant, which consists of removal of fetal remnants from the angle versus trabeculotomy in the adult, whose object is to incise the angle wall that is, the trabeculum itself. In the May issue of the *Archives of Ophthalmology* an article appeared by Hughes and Gartner in which they recommended the removal of the aqueous, substituting air thereby deepening the anterior chamber so that it is possible to perform goniotomy in cases with a shallow chamber as well as in those cases with a wide angle.

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described by Krimsky. A prism is held in front of the fixing eye with the apex toward the nose in a convergent squint. This causes the eye to shift toward the nose to resume fixation and the squinting eye will make a corresponding shift away from the nose. Thus using the fixing eye as a handle, and varying the size of the prism the squinting eye can be moved back and forth until the corneal reflex is accurately centered. This is exactly what is done with a Priestly Smith tape but the prism reflex test is considerably simpler to use. It can be used only for monocular squints. The perimeter is still the best method for obtaining distance measurements on a patient with poor fixation in one eye.

As soon as the child is old enough to cooperate (3 to 5 years of age) and if both eyes are capable of fixation the cover test of Duane is the method of choice for measuring squint. This method has been admirably set forth in the writing of the late James W. White. It will do all that he has claimed for it and we should all learn to rely on it very largely in the measurement of squint.

#### TREATMENT

Regarding the actual treatment of strabismus, it hardly seems necessary to urge that these children be seen as early as possible after 6 months of age. Unfortunately some pediatricians still advise waiting to see if a deviation will be outgrown but I believe that their number is diminishing. Possibly not much will be done in the way of treatment until the child is a year old but it is worth while to see him earlier to watch developments. Occasionally operation will be indicated as will be discussed later. Whatever therapeutic measures may be required it is undeniable that the earlier they are employed the more complications, such as amblyopia, abnormal retinal correspondence and muscle changes will be avoided or minimized and the chances will be better for binocular vision and fusion.

I believe that there is general agreement as to the value of giving glasses that fully correct any significant hyperopia or astigmatism. The accommodative squints do not often appear before a year, but the glasses should be worn as early as possible.

*Amblyopia.* In this air minded age good visual acuity in both eyes has become even more essential. This means that the correction of amblyopia ex anopsia is the responsibility of the ophthalmologist. Such correction can be accomplished in the majority of patients under 8 if time is taken to impress parents with its importance. Again the earlier occlusion is begun the more quickly will the result be obtained. As mentioned above, it is not necessary to wait until the vision can be measured to know that you are dealing with amblyopia. If the squint is solidly monocular you can assume that the squinting eye is amblyopic and proceed with occlusion. By watching the behavior of the eyes when the occluding bandage is changed, one can proceed with confidence and safety. As long as the originally fixing eye resumes fixation whenever the bandage is removed, the objective has not been achieved. In young children, it is easy to cause fixation to shift to the previously squinting eye, an event that distresses the mother but pleases the doctor because it proves that both eyes are sound. There is no way to differentiate amblyopia ex anopsia from a true amblyopia in little children so all patients should have a trial course of total occlusion for at least 2 months. At the beginning of occlusion anything short of total occlusion 24 hours a day is apt to be a waste of time. It is easier for the child to have it on all the time it will bring the result most rapidly. A firm adhesive bandage over cotton, is the occluder of choice. Later and this will vary from 2 to 8 weeks or more, various occluders can be used on the glasses, but I rely largely on atropine in the better eye with paper on that spectacle lens. It should be apparent that atropine alone will be successful only in cases of slight amblyopia or extreme hyperopia when combined with an occluder on the spectacles, the drug will only succeed after the squinting eye has acquired the ability to fix.

#### ORTHOPTIC EXERCISES

It is extremely difficult if not impossible to get an idea of the true value of orthoptic exercises from the literature. There is no way to reconcile the highly optimistic report of results obtained by Berens and his associates

with the completely negative report of Fowler, both are competent reporters but they cannot possibly both be right. Unfortunately in the majority of articles reporting indications for orthoptic exercises and the results of orthoptic treatment, definitions and classifications of cases are either absent or so indefinite that few conclusions can be drawn. There is yet no unanimity about the value of orthoptics. In the opinions of many ophthalmologists, it has failed to achieve an established position in the treatment of squint. Yet it is being used by far too many reliable clinicians to be ignored.

It has not been my practice to use orthoptic exercises routinely in healing strabismus. This decision was reached after experience gained while in charge of an orthoptic Clinic at Vanderbilt Clinic, in New York, from 1935 to 1938 while serving on the American Orthoptic Council for several years and from reading the orthoptic literature closely. There are two principal reasons for my decision. First, it was not possible for me to predict the outcome of orthoptic training with sufficient accuracy to feel justified in prescribing it for my patients. No doubt there are orthoptic technicians who can make fair prognostications of their own management of these cases. However if an ophthalmologist is going to use this method of treatment, he too must be able to tell his patient approximately what he has a right to expect in a given time. At the present time I am unable to do this.

My second reason is that I do not have the facilities for carrying out the treatment. Most of us do not have a sufficient number of muscle cases to employ a full time technician. The obvious solution is for several ophthalmologists to pool their cases and resources and set up a technician in a separate office. This has been done in a few cities with notable success but, at present, I know of only one technician in New York to whom private patients can be sent. As you may surmise, she is far too busy to do more than see an occasional case for any one doctor.

In spite of other practical obstacles there is no doubt that there is value in orthoptic exercises, that some patients with accommodative squint would get rid of their glasses more quickly and more certainly with training than

some patients with small deviations could avoid operation and more patients could achieve binocular single vision with fusion after operation. We need to learn a great deal more so that we will know which cases offer reasonable prospects of success and so that accurate prognoses can be given to our patients. In this direction, I hope to see many new orthoptic clinics established.

*Age and indications for operation* In recent years the trend in this country has been toward earlier operation until it is now not uncommon to do the operation while the child is in the neighborhood of 1 year of age. These early cases are of course those born with the squint, which means a true muscle anomaly. These are nearly all marked deviations with frequently a vertical complication. While refractive errors can hardly play a part at this age it is probably wise to do retinoscopic and fundus examinations, under ether if necessary. It is usually apparent that nothing but surgery will correct the deviation. The parents are distressed and embarrassed over the appearance of their baby. The avoidance of secondary muscle changes and the chances of re-establishing binocular vision, all greatly outweigh the disadvantage of operating without a complete analysis of the case. This analysis could be gained only after long delay.

In the larger group of cases that come on gradually after the second year and have more or less relation to accommodation operation should be delayed until other measures have been tried. Glasses should be worn for several months amblyopia corrected and possibly there should be orthoptic training. When these measures have been carried out, abandoned or considered unsuitable, operation is indicated regardless of the age. However, for psychological reasons great effort should be made to complete the essential preliminaries and to perform the operation before the child enters school. For the same reasons it may be desirable to shortcut the preliminaries in some cases and operate earlier. A serious objective to orthoptic training is that valuable time may have to be lost in waiting for the child to attain an age when exercises can be given.

Only in those cases with high hyperopic errors (usually +4 or more) where the deviation

is largely eliminated by glasses, should the operation be postponed indefinitely. The majority of these children will not require operation and at around 15 years they will be able to remove their glasses when not doing close work. When the occasional operation becomes necessary only that portion of the deviation remaining when glasses are worn should be corrected. Care must be taken not to weaken convergence unduly.

*Choice of operation.* It is almost impossible to tell someone else what procedure to do for a given deviation. Each surgeon must decide which of the many modern techniques makes the most sense to him and which he can do best. Exactly similar results can probably be obtained in several ways. Mention of a few general principles may be helpful. For the usual concomitant esotropia which measures a little greater for *near* than *distance*, a resection of the externus and a recession of the internus of the same eye are my choice. I operate on the squinting eye because it makes sense to the parents and the muscle changes will be in this eye. If there is a conspicuous overaction of the inferior oblique of that eye, a recession of this muscle at its insertion is done at the same time. Even if the overaction is bilateral, the inferior oblique of the fixing eye need not be touched as its overaction rarely becomes manifest. When the deviation is greater for *distance*, emphasis is placed on the resection of the externus when much greater for *near*, the recession of the internus is stressed, or possibly divided between the two eyes. In alternating esotropia, it seems logical to operate on both eyes and while this would probably give the best result, it is not practical to operate on 4 muscles when not absolutely necessary so I would handle them like the monocular squints. An exception to this is the very young alternator who uses the right eye to look to the left and the left to look to the right, and never abducts either eye. Here, bilateral recessions of the interni are indicated. In alternators there will frequently be bilateral overaction of both inferior obliques. If these are approximately of equal amounts and not extreme, they can usually be ignored.

The question of how much to do to correct a given deviation is constantly asked by the

Residents. The best suggestion that I can offer is the figure that Dunnington and I reached several years ago when we analyzed a fairly large series of our operations. We found that when we did a 10 millimeter resection of the externus and a 4 millimeter recession of the internus, on the same eye, we averaged 40 diopters of correction. This is only a rough guide but it provides a starting point.

While I do not want to stress technique because I believe that the many minute variations that have been described are unimportant, I do want to make an appeal to each surgeon to perfect his own technique. It is important that he be able to reproduce an operation with precision as that is the only way that he will be able to find out just what his operation will do. Eventually he will be able to translate accurate measurements into definite, predictable surgical results. I have been using the resection described by Lancaster for several years. Being able to tie the 2 mattress sutures while the tendon is still held firmly in the muscle clamp appeals to me as safer and more definite than other methods. For the recession of the internal rectus, I use two single arm sutures, one in the upper third of the tendon secured by passing the needle through the tendon a second time, and the other in the lower third of the tendon both placed as close to the insertion as possible. Great care is used at this point to waste as little of the tendon as possible. The sutures are then passed through the superficial fibers of the sclera, a measured distance from the stump and at least 8 millimeters apart so as to spread the tendon flat. The conjunctiva is closed with care, 3 to 5 interrupted sutures being used. The recession of the inferior oblique is done by the method described by White (9). It seems to offer the best possibility for a graded weakening of this muscle. Avertin and ether anesthesia is routine. No cocaine plain catgut sutures or traumatic needles are used throughout. I bandage only the eye operated upon and do not use atropine. The bandage is changed on the second operative day and removed entirely on the 4th or 5th. These details are mentioned only because they may be of interest, not because I believe that they are necessarily the best.

## SUMMARY

Early examination by means of the symbol E to test vision, and measurement of the deviation by means of the corneal reflexes and the prism reflex test are emphatically recommended.

Treatment should start as early as possible and should include occlusion in all cases of monocular squint.

The reasons for not using orthoptic exercises routinely are stated.

Operation can be done safely at 1 year and in certain cases gives definite advantages when done early.

The indications for operation have been discussed and my choice of operations has been given briefly.

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## A NEW TYPE OF BASKET IMPLANT FOR USE AFTER ENUCLEATION

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**C**ONSIDERABLE thought has been given recently to the possibility of improving the cosmetic result in enucleation or evisceration procedures. It is probable that out of this interest will come improvements that will stand the test of time and use.

The ideal cosmetic result should achieve the following

1. Wide range of co-ordinate movement with the remaining eye.

2. Instantaneous movement over a short range.

3. Normal lid contour i.e. (a) no sagging of lower lid (b) no sinking in of upper lid.

4. Permanence of the implant. This implies that it shall not migrate or be extruded.

No procedure, whether enucleation or evisceration, with or without an implant has achieved all of these results up to this time. Different procedures have been devised as recently revealed by Dimitry that have resulted in a good movement of the stump but the problem has always remained of transmitting this movement to the prosthesis. The basket type implant to be described is a step toward improving the transmission of this movement from the stump to the prosthesis on what might be called conventional lines, i.e. the prosthesis is completely enclosed in tissue.

The purpose of a basket implant, with a resulting depressed area in the socket, is to give the prosthesis, which has a stud projecting posteriorly (Fig. 1) a grip on the stump. This necessitates, of course, a custom-designed prosthesis and, in addition, imposes new problems of design on the artificial eye maker. This is due to the fact that there is more ability of the cuplike depression to move the artificial eye than there is space in which the eye can move. Thus, it is necessary to adjust carefully the

size and shape of the prosthesis in order to use the minimum amount of space and still maintain a normal fissure. This is facilitated if no attempt is made to fill out a depressed upper lid with the prosthesis, but that is left to the surgeon.

The standard basket now used is shown in Figure 2A and B. It is made of lucite (methyl methacrylate) and measures 11 by 15 millimeters. This size seems to be the best whether the eye to be enucleated is large or small. The anterior edge is slightly thickened, the sides of the basket are fenestrated to allow for invasion of tissue. In addition, there are 3 holes in the bottom, measuring 1 millimeter in diameter, 2 of which are for sutures. Larger and smaller baskets have been tried but a tendency to reduce movement has resulted in either case. Other materials are being tried, but lucite has been found satisfactory up to the present time. A lucite button, measuring 5 by 8 millimeters, with four 0.8 millimeter holes (Fig. 2C) is used to tie the sutures through and maintain the depression during healing. Three double-armed sutures are used: black No. 0 nylon, blue No. 00 dermal and purple coarse dermal. These are used because of their greater strength and smoothness, allowing sutures to be pulled up without breaking. They are of different colors to permit ready identification. One inch (2.5 cm.) straight intestinal needles are used to allow their passage through the plastic button.

At the end of the operation a special plastic retainer (Fig. 2D) is placed inside the lids after the method of Gifford. This greatly reduces postoperative edema, keeps the basket centered, and completely prevents any prolapse of the conjunctiva. The average operating time for this procedure is the same as for any implantation procedure, namely 22 to 25 minutes.

Two baskets slightly smaller than the standard have been placed inside the sclera after

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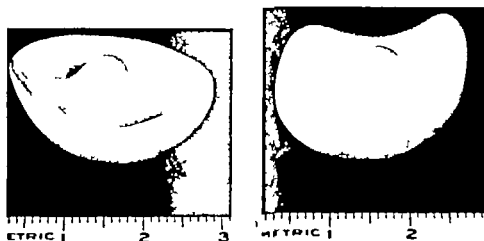


Fig. 1 Plastic prosthesis showing projecting stud on posterior surface.

visceration. No advantage accrued as far as movement of the stump was concerned and the depression into which the stud of the prosthesis fits was considerably smaller. In addition, there was extreme postoperative edema involving the entire side of the face which lasted 7 to 10 days. I have seen 2 cases in which a ball implant was placed in the sclera with extremely good movement practically as good as that of the normal eye but because of the smooth contour only a small amount could be transmitted to the prosthesis.

The muscles are not sutured in this procedure. Figure 3 shows the posterior view of a basket implant removed at autopsy 8½ months after operation from a patient who was killed in an automobile accident. It will

be seen that all the muscles including the obliques are attached near the rim of the basket.

#### OPERATIVE PROCEDURE

Anesthesia is induced by intravenous injection of sodium pentothal and retrobulbar injection of 2 cubic centimeters of 2 per cent procaine hydrochloride.

The eye is prepared in the usual manner. A speculum (Weeks) is inserted, the conjunctiva dissected from the limbus, and the dissection carried to the fornices in all directions. The rectus muscles are then isolated and cut free from their insertions. The conjunctival opening usually is enlarged nasally and temporally about 2 millimeters to permit passage of the globe. The globe is grasped with fixation

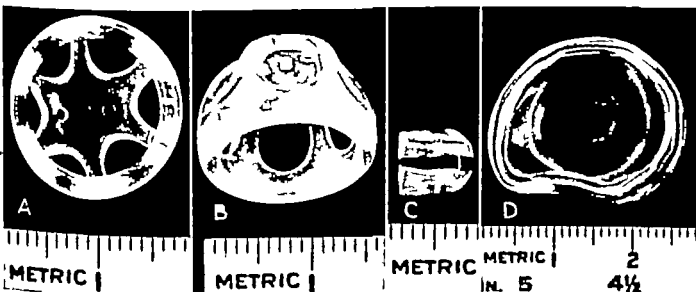


Fig. 2. A, Top view of Lucite basket. B, side view; C, Lucite stud. D, posterior view of Lucite with central depression for stud.





Fig. 3. Posterior view of basket, implant removed at autopsy 8 months following implantation showing muscles attached to anterior edge.

forceps at the tendon of the internal rectus muscle and the nerve cut with enucleation scissors. The prolapsed globe is then freed from the oblique muscles and removed.

A dry gauze sponge and a little pressure usually reduce the bleeding quickly to enable one to inspect Tenon's capsule (Fig. 4).

The basket with one black nylon suture, size No 0 fitted with two straight 1 inch

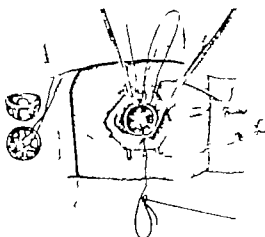


Fig. 5. Basket with N. black nylon suture inserted suture carried through Tenon's capsule and conjunctiva at 12 and 6 o'clock.

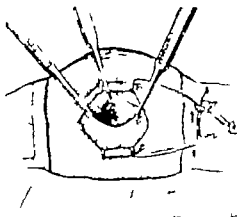


Fig. 4. Tenon's space exposed, ready for insertion of basket implant.

intestinal needles, is then placed in Tenon's capsule (Fig. 5). The upper suture is brought through a firm bite of Tenon's capsule at 12 o'clock and out through the margin of the conjunctiva. The lower suture is brought out similarly at 6 o'clock.

A blue No 00 dermal double-armed suture with 1 inch intestinal needles is then carried through Tenon's capsule and the conjunctiva about 2 millimeters on either side of the black suture which was placed at 6 o'clock (Fig. 6A). Each suture is then carried through in a simi-

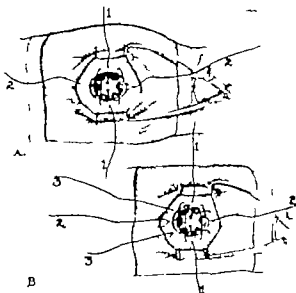


Fig. 6 A, Blue dermal mattress suture, carried through Tenon's capsule and conjunctiva on either side of black nylon from within outward and finally through Tenon's capsule and conjunctiva 12 and 6 o'clock.

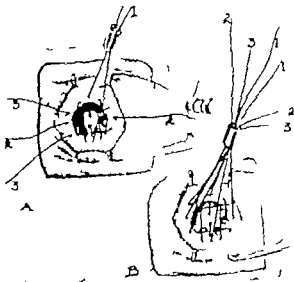


Fig. 7. Black nylon suture 1 carried through holes in lucite stud B purple dermal suture, 3 carried through the same holes in stud as suture, 1 Blue dermal suture, 2 carried through the other two holes in lucite button

lar manner at 12 o'clock. The suture on the right side is now carried through Tenon's capsule and the conjunctiva at 3 o'clock on the same side and the suture on the left at 9 o'clock.

A purple dermal (coarse) double armed suture, similar to the blue dermal suture is now placed about 2 millimeters on either side

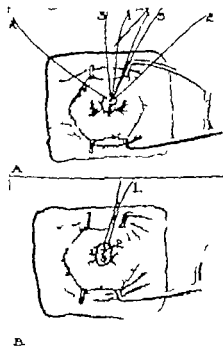


Fig. 9. A Suture, 2 pulled up, imbricating Tenon's capsule and conjunctiva vertically B Suture 2 tied and cut. Suture 3 pulled up tight and cut through, imbricating Tenon's capsule and conjunctiva horizontally and closing the basket opening.

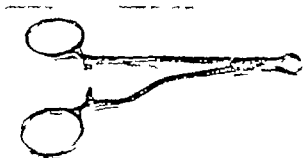


Fig. 8. Button holder

of the blue suture at 3 o'clock, the needle taking similar bites of Tenon's capsule and coming out through the conjunctiva. These two sutures are now carried across above all other sutures and brought out 2 millimeters on either side of the blue suture at 9 o'clock (Fig. 6B).

These two mattress sutures (blue and purple) are placed as outlined in the preceding paragraphs so that when they are pulled up they cause a double imbrication or folding of Tenon's capsule and the conjunctiva and the black sutures still come out through the upper layer after this has been done. All sutures are carried through the lucite stud, as shown in Figure 7A and B. Sutures 1 and 3 pass through the same two holes and suture 2 through the other two holes.

While the assistant holds the button with the lower end at the level of the rim of the basket with the button holder (Fig. 8) the blue suture is pulled up, tied and cut (Fig. 9A) and then the purple suture is similarly

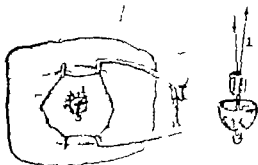


Fig. 10. Suture 1 pulled up, tied and cut forcing button with Tenon's capsule and conjunctiva down into the basket.



Fig. 1 Plastic retainer

handled. This pulls Tenon's capsule and the conjunctiva into place and closes the opening.

A single tie is now placed in the black suture and as this tie is gradually pulled up the index fingers make traction and a little pressure. The assistant then releases the button from the forceps. As this tie is pulled tight, it forces the button with Tenon's capsule and the conjunctiva down into the cup. Three knots are placed and the suture is cut (Fig. 10). No conjunctival sutures are necessary.

A lucite retainer is placed inside the lids. An adhesive dressing with firm pressure but with no roller bandage is applied.

#### POSTOPERATIVE COURSE

The first dressing is done on the third postoperative day, the retainer being removed and

the socket irrigated. The retainer is replaced and if there is still some edema an adhesive dressing is put back on for 2 more days. In most cases the dressing can be omitted. On the fifth postoperative day the sutures and the button are removed. A temporary retainer with button attached (Fig. 11) is placed in the socket at this time. This is removed daily and the socket is irrigated for a week.

In none of the cases in which operation was performed has there been any prolapse of the conjunctiva. This is probably due to the type of operation and to the retainer. In general, there has been little reaction and no discomfort at all after the first postoperative day.

At the end of 2 to 3 weeks, depending on the shrinkage of its tissues, the socket is ready for a custom made prosthesis, similar to the one shown in Figure 1.

#### COMPLICATIONS

It is important not to pull the sutures beyond the snug state, as otherwise pressure necrosis and exposure of the bottom of the basket will result. This complication will also occur if the button is not removed at the end of 5 days. If exposure of the bottom of the basket does occur, a retainer without a button attached is put in, and granulation and epithelization will take place in a few days, without impairment of the result. If after the sutures and the button are removed on the fifth post

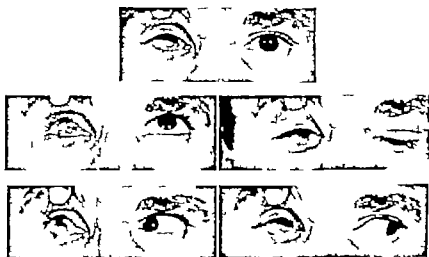


Fig. 12. Appearance of socket in patient's mouth after operation, showing impression in the basket and the range of motion.

operative day there is a thin appearing lining on the bottom of the basket a plain retainer can be used from 1 to 3 days and then a button retainer employed

A sufficiently firm bite of Tenon's capsule must be obtained in placing the mattress sutures, since there is slight tension on the capsule when it is inverted into the basket. In 2 cases in which a ball implant was removed and a basket put in the sutures did not hold. This was also true in a case in which a considerable amount of scar tissue was present—the sutures cut through the inelastic scar tissue. It was necessary in these 3 cases to remove the baskets.

Postoperative hemorrhage has never been a problem in our cases. In the 3 cases just mentioned in which the sutures did not hold because of scar tissue and the basket was removed approximately 10 days after operation, it had to be dissected out. Certainly the basket cannot be extruded.

#### PROSTHESIS

The socket is ready for the final prosthesis at the end of 2 or 3 weeks. This has been of plastic, made according to the standard Army procedure and under the direction of Captain Stanley F. Erpf and Captain Arthur L. Lund

blad of the Dental Corps of the Army of the United States

The prosthesis is not made from an impression of the socket, since that would result in its occupying too much of the available space. Figure 1 shows some variations in the prostheses that have been fitted. In general, the stud is adjusted to fit into the depression and the base around this stud is cut away to allow the edge of the basket to come forward when the socket is turned. Through support of the stud there is considerable relief of pressure on the tissues in the region of the fornices.

It is not absolutely necessary to use a custom made eye with a stud, good movement can often be obtained with a Snellen form. The reason for this is that the movement of the prosthesis is in part due to the change in the shape of the socket when the basket rotates; one side becomes shallow and the opposite side deep and the eye has to move.

The following tabulations were made on the basis of observations on 60 sockets fitted with artificial eyes. Practically all of them were fitted with custom made plastic eyes. It is realized that this small number may not represent a true cross section. The series was collected from the wards without regard to the preoperative condition. It consisted of 20

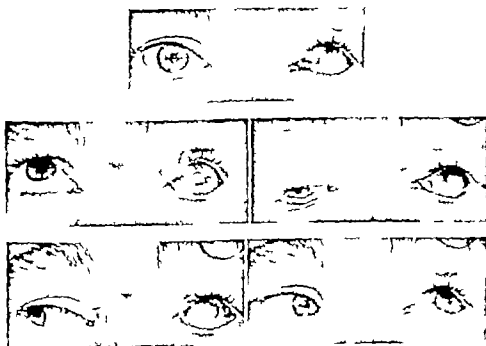


Fig. 13 Patient 5 months after operation showing depression and movement of socket.

sockets without implants 20 with ball implants and the first 20 with basket implants.

Average motion degrees	No Implant	Ball Implant	Basket Implant
Nasally	19	9	25*
Temporally	3	5	12
Superiorly	25	20	20
Inferiorly	12	20*	30
Total	69	74	109

The sockets without implants showed the greatest variation in movement from patient to patient and those with basket implants the least variation. This is illustrated by the following tabulation.

Prosthesis having	No Implant	Ball Implant	Basket Implant
45° total horizontal movement	1 of 20	3 of 20	8 of 20
5° total vertical movement	6 of 20	8 of 20	19 of 20

These tabulations do not indicate the action of the oblique muscles which is a prominent feature of the basket sockets. Neither do they indicate the most important characteristic of all that is, the much more rapid response to movement of the muscle cone, with a notable decrease in the time lag as compared with that for the normal eye.

#### SUMMARY

On the basis of 100 operative procedures, a new type of basket implant for use after enucleation is presented which with a new type of prosthesis, gives more instantaneous movement and a wider range of action. This procedure, combined with use of a plastic retainer eliminates prolapse of implant and shortens the postoperative convalescence period.

# RECONSTRUCTION OF ORBITAL FLOOR DEFECTS

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THE floor of the orbit is triangular in shape and is made up largely of the orbital plate of the maxilla. The orbital portion of the zygomatic bone makes up the anterolateral portion and a small portion of the posterior part of the floor is formed by the orbital process of the palatine bone. The anterior margin is thicker and stronger than the remainder of the floor. The inferior orbital fissure is the lateral boundary of the floor and the infraorbital sulcus runs forward along the central portion of the floor from the inferior orbital fissure to the infraorbital foramen which lies about 1 centimeter below the lower orbital margin. The sulcus and foramen transmit the infraorbital artery and the main portion of the second division of the trigeminal nerve that is the maxillary nerve which is known as the infraorbital nerve as it passes into the infraorbital sulcus.

Trauma to the lower orbital margin with resulting fracture of the margin and floor of the orbit not infrequently produces more severe displacement of the thin floor of the orbit than of the thicker and stronger margin itself. The displacement of the floor is usually downward due to the concave orbital surface of the floor anteriorly and because an air space the maxillary antrum lies below the floor. It is Pfeiffer's opinion that fracture of the wall of the orbit is the entire cause for traumatic enophthalmos. Of 53 cases reported by him 24 had a depressed fracture of the floor with out any fracture of the orbital margin. More than half of these were caused by a blow with a fist. Pfeiffer states that in the cases of less severe enophthalmos the posterior portion is fractured and in the cases of more severe displacement the entire floor is broken through. It is surprising how infrequent there is permanent visual damage in these cases. At times severe trauma to and fracture of the supraorbital area may produce an accompanying

depressed fracture of the floor of the orbit due to transmission of the force through the orbital contents. Depressed fracture of the floor may also occur from the explosive force of shell fragments entering the orbit and from actual perforation of the floor by shell fragments or other foreign elements. It is quite unusual to have an elevation of the floor of the orbit unless there has been a severe crushing trauma to the region of the antrum.

A diagnosis of depressed fracture of the floor of the orbit is made on the history of trauma and the presence of depression of the eyeball with some enophthalmos. Diplopia may be present and also anesthesia or hypesthesia over the distribution of the infraorbital nerve. Immediately following the trauma these signs may be masked by edema and orbital hemorrhage. There may even be an initial exophthalmos. Crepitation from air in the soft tissues and palpable displacement of the orbital margin may be evident. Careful stereoscopic x-rays will usually confirm the diagnosis. There may be marked loss of vision due to internal ocular damage or due to compression of the optic nerve by fracture into the optic foramen or by hemorrhage into the optic nerve sheath in the foramen.

When there has been little or no depression of the floor of the orbit no treatment is indicated. When very definite depression is present it should be corrected as soon as the initial reaction has subsided. This is best done by the otolaryngologist by means of a Caldwell-Luc approach with elevation of the depressed orbital floor and moderate packing of the antrum for a day or two. When this is not done a permanent depression of the orbital floor and orbital contents results. Fracture and displacement of the lower orbital margin should also be corrected as early as possible with internal wiring of the fragments or some method of external fixation if necessary.

When there has been a severe compound comminuted fracture of the lower orbital margin it may be necessary to débride some of the

From the Surgical Service at O'Reilly General Hospital. Presented before the Clinical Congress of the American College of Surgeons, Cleveland, Ohio, December 16-20, 1946.



Fig. Appearance on admission.

Case  
Fig. Final result.

Fig. 3 Wedge acrylic implant.

loose bone fragments. This results in more or less subsequent external deformity.

The purpose of any procedure to reconstruct the orbital floor is primarily to elevate the orbital contents. If sufficient correction of this depression is obtained it will also eliminate the sinking or retraction of the upper portion of the upper eyelid and lessen the enophthalmos. In late cases of depressed floor it is not possible to elevate the floor to its normal position because of the firm adhesions which have formed. In the past this has usually been accomplished by the use of autogenous or preserved cartilage grafts to the floor of the orbit under the periorbital. This is the method used by most of the general plastic surgeons during the past few years in the army general hospitals that were ophthalmic and plastic centers. The taking of an autogenous rib cartilage graft makes an additional procedure and at times the pleura has been accidentally perforated. The use of preserved cartilage has been quite satisfactory although it has been demonstrated that preserved cartilage buried subcutaneously produces a typical low-grade foreign body reaction over a period of months and is gradually absorbed and replaced by fibroblastic tissue. Osteoperiosteal grafts from the tibia have also been used. These are used to bridge the defect and usually require temporary additional support by packing in the antrum. Thus, together with taking of the graft, makes a needlessly complicated procedure.

It was our experience at O'Reilly General Hospital and also the experience of ophthalmologists at some of the other army eye centers, that the use of various inorganic materials has been very satisfactory for orbital floor reconstruction with resulting simplification of the surgical procedure.

In June of 1945 at the suggestion of Dr. Reudemann of Cleveland, Lieutenant Colonel Struble at Crile General Hospital used tantalum wool and later tantalum mesh to fill in defects of the orbital floor in battle casualties in whom the Reudemann implant eye was being used. Struble stressed the importance of careful preoperative x-ray determination of the size of the defect and received excellent cooperation from his roentgenologist, Lieutenant Colonel Shifflet.

During the latter months of 1945 Captain Souders of Dibble General Hospital used rhomboid shaped plates of the plastic acrylic (methyl methacrylate) to cover the defect of the floor of the orbit in old fracture cases who had some depression of the eyeball. Souders used various sizes and thicknesses of these acrylic plates depending on the amount of depression of the eyeball and size of the defect in the orbital floor. The dissection was made through a skin incision along the lower orbital margin but he placed the acrylic plate on the periorbital and not under it. The plate was held in position by sutures through small holes near the anterior edge of the plate and through the periorbital.

About this same time Major DeVoe of Halloran General Hospital used a packing of glass wool under the periorbital in several cases of depressed floor to fill in the defect and elevate the eye and orbital contents. He reported very satisfactory results and no complications.

In the spring of 1945 at O'Reilly General Hospital we began to use a wedged-shaped acrylic implant to the floor of the orbit to elevate the orbital tissues in cases of anophthalmos who had had an enucleation with small implant in Tenon's capsule, or who had had a



Case 2

Fig. 5 Final result.



Case 3

Fig. 7 Final result.

simple evisceration of the eyeball. This procedure proved a quite satisfactory method to eliminate or lessen the retraction or sinking of the upper portion of the upper eyelid. We soon applied this procedure to cases of old fracture of the floor of the orbit with depression of the eyeball and enophthalmos. The acrylic wedges were made in 3 sizes, the average or middle size being about  $2\frac{1}{2}$  centimeters by  $1\frac{1}{2}$  centimeters and about 8 millimeters thick at one end and tapering down to about 4 millimeters at the other end. The operation is similar to that used by Gilles and others except that the wedgeshaped acrylic implant is used instead of a cartilage graft. After incision through the skin and subcutaneous tissue down to the lower orbital margin, the periorbital is incised and the periorbital thoroughly elevated with a submucous elevator. A wedgeshaped acrylic implant is then placed on the depressed floor with the thick end of the wedge posterior. A large enough implant is used to satisfactorily elevate the orbital contents and two or more implants can be used in cases of severe depression of the floor. Traction sutures in the tendons of the lateral and medial rectus muscle are a great aid in drawing the eyeball upward and forward at the time the wedge is being inserted. The periorbital is firmly closed with No. 000 gut mattress sutures. Subcutaneous sutures should also be used to avoid a depressed postoperative scar. A good pressure dressing is important to prevent or lessen hematoma.

Gilles was one of the first writers to recommend the use of cartilage grafts for replacing loss of bone of the orbital rim. This has been used extensively since that time. Landemann in 1916 first described the use of an iliac bone graft to the mandible and this was later ap-

plied to the malar and infraorbital area by a number of plastic surgeons.

During the past few years tantalum plates, tantalum mesh, and acrylic plates have been used to replace loss of orbital margin. Too frequently the preformed tantalum or acrylic plate does not give the proper contour to the overlying tissues. It is difficult to alter these plates satisfactorily at operation. Also it is not a simple procedure to fashion the plate. Tantalum mesh is easily shaped at the operating table but it does not become firmly attached to the surrounding bone. Rib cartilage grafts do not become attached to the bone and also may change after operation. It was the experience of the eye and the plastic service at O'Reilly General Hospital that these inorganic materials and also cartilage grafts did not give as satisfactory results in reconstruction of the lower or lateral orbital margin or malar area, as did the use of grafts of iliac bone. After removal of most of the cortex the cancellous bone can be easily shaped to fill in the defect properly and give a very satisfactory contour to the overlying tissues. If the ends of the graft rest on exposed bone it soon becomes firmly attached to this bone. A blood supply is rapidly formed into the grafted bone and a cortex or pseudocortex forms on the surface of the graft. Postoperative hematoma will seldom cause trouble if a narrow rubber



Fig. 8.

Case 4.

Fig. 9.







Case 7

Fig. 15. Appearance on admission

Fig. 16 Before bone graft.

Fig. 17 Result.

CASE 5 (Figs. 10, 11 and 12) Patient was struck in the right orbital area with a large stone and incurred severe compound depressed fracture of supraorbital area and of the floor of the orbit. Debridement of frontal sinus area and repair of lower eyelid performed at another general hospital. Admitted to O'Reilly General Hospital 3 months later. Severe enophthalmos and depression of right eye as well as marked depressed deformity of supraorbital area were present. He had loss of central vision due to traumatic damage to macular area. One month after admission the eye was quite well elevated and the enophthalmos fairly well reduced by means of five acrylic wedge implants to the depressed floor of the orbit. Recovery was uneventful. Two months later an iliac bone graft to the supraorbital area was performed by Lieutenant Colonel Karlson.

CASE 6 (Figs. 13 and 14) Patient incurred a compound comminuted fracture of right zygoma and severe laceration of right eye from shell fragment wound. The right eye was enucleated 3 weeks later and 1 month following that a large cheek flap rotated to fill defect over zygoma region. He was admitted to O'Reilly General Hospital 6 weeks later. There was a long broad depressed scar from lateral lower orbital margin down to angle of jaw with loss of malar eminence and of lateral lower orbital margin. The lateral canthal area was drawn down about 1/2 centimeter. Three months later an iliac bone graft was used to reconstruct the lateral lower orbital margin and malar area, with excision of much of the scar. Two months later the lateral canthus was elevated by means of a Z-plasty or interposition of flaps.

CASE 7 (Figs. 15, 16, and 17) Patient incurred severe compound comminuted fracture of right zygoma and maxilla with avulsion of lower eyelid and anterior segment of eyeball from shell fragment. The wound was debrided the same day. The eye was eviscerated 5 days later. He was admitted to O'Reilly General Hospital 1 1/2 months later. There was a loss of entire right lower eyelid with conjunctiva and skin adherent to the remains of lower orbital margin. Due to fracture of the floor of the orbit there was marked depression of the orbital contents. Several operations were used to reconstruct the lower eyelid and the area of the lower orbital margin was reconstructed with an iliac bone graft. After the eyelid fissure was reopened the orbital con-

tents were elevated by means of an acrylic wedge implant on the floor of the orbit. A fascia lata graft was used to correct the retraction below the brow.

### SUMMARY

Fractures of the floor of the orbit should be reduced soon after injury if feasible.

When late reconstruction is indicated the orbital contents can be very satisfactorily elevated by means of an acrylic implant on the depressed floor. Other materials such as tantalum mesh and glass wool have been satisfactory in the hands of some surgeons.

Small losses of the lower orbital margin can be satisfactorily filled by a fascia lata graft. Larger losses are best reconstructed by a graft of cancellous iliac bone with more consistently good results than cartilage grafts or preformed tantalum or acrylic plates.

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## THE RECONSTRUCTION OF THE UPPER LID

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WHEN considering this subject, 'The Reconstruction of the Upper Lid' almost every person who has had experience with ophthalmic plastic surgery will immediately think of some more or less complicated case in the correction of which he had a part. The difficulties and complexities of such individual cases are most stimulating—of this there is no doubt. Nevertheless such cases as all others are corrected through certain basic principles peculiar to the subject, and common to all these conditions.

Regardless of any one technique these principles can be divided into two major subdivisions—when reconstructing an upper lid is a good functioning eyeball present, and is the socket surgically anophthalmic? These two possibilities modify the surgery necessary to a tremendous degree.

A second group of three probable conditions which influence the necessary surgery and contingent upon the first subdivision are the eyelid defects themselves. First, is the deformity under treatment the result of the loss of the external layers of the lid only with normal conjunctiva present second in the case considered are all the structures of the lid both anterior and posterior surfaces, wanting even partly and third are only the posterior lid surfaces and structures predominately deficient?

The presence of an intact functioning eyeball in lid reconstructions compels, without permissible modification the use of conjunctiva or of mucous membrane for the reconstruction of the posterior surface of either lid. The absence of an eyeball, that is surgical anophthalmos, permits the use of epithelium either as a free skin graft or as some type of pedicle flap for replacing the lost posterior surface of the reconstructed lid. The reconstruction of a lid in cases in which no eyeball

is present is a simpler procedure because demands are less exacting. Even the question of later lid motility is relatively insignificant, because corneal exposure and difficulties from that are not a problem. As a matter of fact in many of these cases the ideal result hoped for is that of good looking fixed lids which will retain a prosthesis satisfactorily even though they may be quite immobile.

A third consideration of importance in the reconstruction of a lid especially the upper lid is a thorough knowledge of the rather complex anatomy of this lid. Surgical principles which are harmonious with the anatomy of the upper lid are certain to give much better results than any technique which disregards this anatomy. One must remember that the lid has two major parts—a posterior conjunctival and tarsal plate surface or layer and an anterior muscle and skin layer. The muscle pull of the levator palpebrae superioris is at a right angle to the muscle action of the orbicularis fibers. The two muscles lie in entirely different planes. These two muscles are not only antagonistic, one to the other but both are very active muscles. Last the two canthal angles are themselves quite immobile but here the two muscles have common attachments.

Reconstructive surgery for the correction of defects in the posterior surface of the lids is essentially the reconstruction of a cul-de-sac by means of mucous membrane. Cicatrices may be present simultaneously in the external surface of the lid, which needs reconstruction and resuture but this is a minor part of the surgical procedure. A free graft of mucous membrane sutured into a correcting position is the basic essential (Fig. 1).

This same situation, when present with surgical anophthalmos means a necessary correction either with the same type of graft or by means of a free skin razor cut graft. This must be cut as thin as is humanly possible. In these instances the external surface

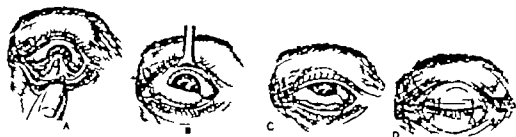


Fig. 1. Mucous membrane correction of the posterior surface of a defect of the lid.



Fig. 2. Simultaneous correction of posterior and anterior surfaces of the upper lid. Prosthesis in position.



Fig. 3. The major portion of the upper lid is lost with much cicatrix present. The entire superior cul-de-sac is absent. A pedicle flap from the forehead and a free skin graft to the posterior surface of the lid.

of the lid which is deficient may be corrected simultaneously with either a pedicle flap or a free skin graft. Figure 2 is such a case. The superior cul-de-sac of the deficient socket was corrected by mobilizing the remains of the upper lid still present, swinging these inward upon themselves as a hinged flap to form the new posterior surface of a new lid. At the same time, the anterior surface of this lid was corrected with a free skin graft. It is in this type of case that the use of supraclavicular skin has such impressive successes. Figure 3 is a similar case in which the correction of the external surface was achieved by means of a pedicle flap from the contiguous regions. A free razor cut epithelial graft was placed on the posterior surface of the lid flap. A pedicle flap had to be used here because of the extensive scar in the tissues remaining. To remove all of that meant the removal of almost the entire lid. In general pedicle flaps are to be

used only when necessary, never as an operation of election. When that is so as in this indication there need be no hesitancy about their use. If properly executed the additional scarring which they cause can be held to a minimum often to an amount quite inconsequential. The value of a pedicle flap lies in the ability to transplant larger portions of epithelium under difficult circumstances (anatomic, naturally) with a greater chance for continued viability in the graft than if that same amount of skin had been transplanted freely and without this added means for nutrition i.e. the pedicle.

The ideal reconstruction of an upper lid in the presence of a normally functioning eyeball assuming that both the anterior and the posterior surfaces of the lid have been lost in part depends upon a technique originally advanced by Landolt in 1921 and subsequently carried to even greater general use



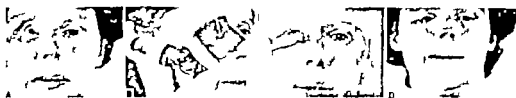


Fig 7 The complete correction of the upper and lower lids by an epithelial lined flap

form a smooth lid margin. That tarsus which formerly lay in the lower lid will now lie in part, if not wholly, in the upper lid. The conjunctival surface of the two lids is usually quite adequate for good function. Figure 5 is an illustration of this technique. The entire upper lid was not lost but the major part was missing. The illustration in center shows the intermarginal attachments. The curve of that points out rather clearly the total amount of new tissue now lying into this position. The illustration at right shows the new palpebral fissure following its formation—also the degree of closure possible.

In this case the lashes were suggested by a line of tattoo marks at the new lid margin. A hair bearing graft for the eyelashes of the upper lid can be placed into position rather readily prior to the formation of the new palpebral fissure. Such a graft should be taken from the lower edge of the opposite eyebrow cut with beveled edges and sutured into position.

A second technique to be considered under similar circumstances i.e. eyelid defect in the presence of a good functioning eyeball necessitates the implantation of a mucous membrane graft into either the forehead or the upper lid immediately beneath the skin surface, to prepare the necessary graft with a posterior mucous membrane layer which will function as conjunctiva. This graft either as a free graft or as a pedicle flap is then transplanted to its correcting position for the simultaneous reconstruction of both the conjunctival and skin surfaces. Figure 6 shows the utilization of this basic principle by means of a pedicle flap. Mucous membrane covers the posterior surface and epithelium the anterior surface. Some of the principles of Wheeler's halving operation will apply in the utilization of this technique. This is so because those principles of Wheeler's are basic with ophthalmic plastic surgery whenever accurate car-

entry is necessary in lid surgery. They are not characteristic of any individual procedure.

The mucous membrane to be used is taken from the buccal mucosa, trimmed to maximum thickness, wrapped over a mold, and then buried into a pocket prepared for it. After this has taken surgically any portion of the mucous membrane may be transplanted with any amount of epithelium needed. In the instance shown a certain portion of the lid remains were rearranged and utilized by scar resection and by suture. The case was one of postmalignancy reconstruction. Somewhat less than one-half of the lid was still wanting following that. The mucous membrane epithelium pedicle flap was quite sufficient for a good correction. That portion of the rather conspicuous mucous membrane still present upon the skin of the lower lid had to be removed and the area covered with a skin graft. Skin from the supraclavicular region or from the opposite upper lid are equally satisfactory for this.

Hughes carried out this principle of combined mucous membrane epithelium graft by implanting the mucous membrane into a pocket of the opposite lid. Skin and mucous membrane were then transplanted as a free graft. Even though this technique was successful for the lower lid and perhaps should be



Fig 8. An epithelial lined pocket on the face prior to transplantation for a new upper lid.



Fig. 9. A, left, Deformity of upper lid corrected by scar resection and resuture, also with a necessary enucleation. B 3 months following surgery

recommended for that, the use of a flap is better for an upper lid repair

The complete correction perhaps better expressed as correction for the more or less complete loss of an upper a lower or of both lids, in the absence of an eyeball is similarly done but with epithelium rather than with mucous membrane. A pocket of epithelium is formed on the forehead or beneath the skin of the upper face. Following that one may transplant a flap having two epithelial surfaces, an anterior and a posterior surface thus making possible correction for the complete loss of one or more lids. The principle is quite like that described in detail for the use of mucous membrane but the absence of an eyeball permits the use of epithelium for the posterior surface of the new lids. Figure 7 illustrates such a case before and after its correction. Figure 8 shows a pocket upon the face before transplantation to an upper lid.

In this presentation the only cases considered for the explanation of the rules for lid reconstruction were those in which there had been a loss of soft tissue to such an extent that the replacement of these tissues was necessary for the correction of the case. Many cases could be presented wherein the correction was obtained by simple (meaning uncomplicated and not ease of performance) scar resection resuture and the reposition of those tissues still present to correct the plastic defect present. Figure 9 is such a case. The necessary enucleation of the phthisical eye had little effect upon the condition of the lid. Scar removal and suture were responsible for the satisfactory result obtained. This possibility as a surgical principle must be remembered in the

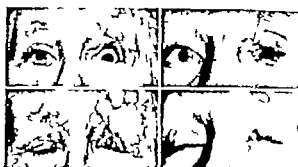


Fig. 10. A, left, Extensive ectropion following herpes, the lids opened and closed. B Correction with a nasotomized free skin graft.

consideration of cases for correction. It is properly included herein considering the title of the paper and the scope of its subject matter.

#### RECAPITULATION AND CONCLUSION

In this presentation such defects as ectropion entropion symblepharon etc., have not been the basic conditions under consideration. The extent of pathology possible in some of these conditions, however as illustrated in Figure 10 might permit one to consider this degree of deformity worthy of the term—lid reconstruction. It is, nevertheless only a case of extensive ectropion and as such is to be corrected by procedures rather well established for this type of condition.

The real purpose of the paper has been to outline the principles underlying lid reconstructions, and especially when applied to the upper lid. The different anatomic possibilities which present themselves for correction differ so decidedly in their demands and hence in the permissible surgical techniques available for correction that it was thought necessary to emphasize again that basic fact.

These surgical principles as they have just been discussed are the result of clinical experience and as such they should be seriously considered as these cases appear for correction.

# THE MANAGEMENT OF NONMAGNETIC INTRAOCULAR FOREIGN BODIES

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THE character of intraocular foreign bodies coming to the ophthalmic surgeon's attention has changed materially in recent years. Formerly 95 to 98 per cent were magnetic, leaving a bare 2 to 5 per cent of cases to which the magnet was not applicable. Now some series of cases are reported in which the nonmagnetic percentage runs as high as 10 and even 40 per cent.

The ratio of nonmagnetic to magnetic intraocular foreign bodies was always higher in battle casualties than in civilian life. This ratio took a sharp rise with the nefarious introduction by the Axis forces of nondetectable nonmagnetic land mines in the North African Desert campaigns as reported by Stallard (16). The World War II experience of the United States Army Medical Corps is well described in Wilder's report, that out of 150 enucleated eyes received at the Army Institute of Pathology 89 harbored nonmagnetic particles.

The increased use of alloys containing copper, aluminum, brass, lead, zinc, manganese, nickel, etc. in industry as well as war thus presents new and difficult problems. In addition to these one runs across eyes harboring glass, plastics, coal, stone, sand, lashes, grit, wood, and other substances.

Our miracle tool the magnet is worthless in application to nonmagnetic substances. Nor does it attract steel alloys containing considerable manganese. Often the ophthalmologist was thus made to despair on seeing a patient with a nonmagnetic intraocular foreign body. New simplified and improved x-ray and other localization methods with improved surgical techniques have made it possible to save some of these eyes from blindness. Several problems present themselves when one is called to attend a traumatized eye.

1. How shall one proceed in the average case of ocular injury?

2. When should an intraocular foreign body be suspected?

3. How much damage has been done to vital structure?

4. Is a foreign body present within the eye and how can we readily localize it accurately?

5. How does one differentiate the nonmagnetic from the magnetic foreign body?

6. To what extent does infection complicate the picture and how shall we control it?

## HISTORY

The ophthalmologist should investigate the possible presence of an intraocular body in every case of possible injury and especially in uveitis. The history is most important. The examiner must question the patient in detail about the likelihood of exposure to injury while hammering, chiseling, or working with rotating or moving machinery. One should note whether the patient was near flying particles or near an explosion or in proximity to shattering solids. An investigation of the tools and substances in use at the time of accident gives a clue as to the likelihood of the intraocular particle being magnetic or otherwise. It also may tell us whether the fragments are glass or stone, or copper, or steel, etc.

Stallard (16) writing of his North African war experiences found a clue to the nature of the intraocular fragments by examining small particles lodged in the skin of the lids and face. U.S. Army ophthalmologists have examined injured eyes which contained more than one particle, some magnetic and others nonmagnetic. Close questioning of the patient may further reveal the size of the fragment and its course of flight toward the eye. The lapse of time since injury is necessary to ascertain fragments that have been in contact with soil may harbor tetanus bacilli. These and a host of other details may be elicited by a careful history. Previous negative examinations or the story of removal of a superficial corneal



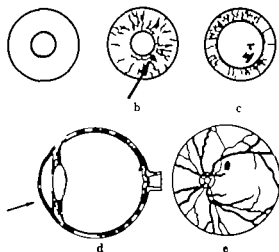


Fig. Course of foreign body through the globe and trauma caused to a, cornea (perforation) b, Iris (arrow points to hole) c, lens (tract through it) d, Section of globe showing tract of particle, location of foreign body and vitreous opacities due to hemorrhage e, Foreign body lodged in retina, as viewed with ophthalmoscope.

particle should not lead us astray. There are many cases on record dismissed with a pat on the shoulder which later turn up with siderosis or chalcosis or a cyclitis due to an intraocular foreign body.

#### THE EXAMINATION

Both eyes must be examined subjectively and objectively. One may find evidence of disease, of injury or even of sympathetic ophthalmia. Visual acuity and field examination of each eye where possible should be followed by complete examination with all the instruments and methods at our command. The anterior segment must be studied with loupe and oblique illumination, with ophthalmoscope, with the transilluminator and particularly with the slit lamp microscope. The cornea, the conjunctiva, the sclera, the anterior chamber, the iris, the lens, the vitreous, the entire visible retina and the optic nerve must be painstakingly scrutinized. If photophobia or pain interfere a drop of local anesthesia such as tetracain 0.5 per cent may facilitate the examination. A perforating wound in the cornea as evidenced by a hole in Bowman's and especially in Descemet's membrane leaves permanent telltale evidence. A hole in Descemet's membrane or in the iris leaves permanent evidence. Discovery of such, however minute is proof of a penetrat-

ing wound and charges the examiner with an exhaustive study to establish the presence of an intraocular foreign body and to localize that foreign body.

The value of exhaustive routine examination is evident from the next 2 cases cited.

**CASE 1.** A.T., mechanic, aged 30 years, complained of occasional discomfort and redness of the left eye. Routine examination revealed a minute perforation of Descemet's membrane. A history of injury 6 months previous while chiseling was finally elicited. The patient remembered that a foreign body was removed from the conjunctiva by a fellow workman. Since then his eye watered in bright light, etc. The first x ray examination was negative. A second x-ray examination by Vogt's soft tissue technique revealed a minute fragment near the iris root. With the aid of gonioscopy it was possible to visualize the foreign body covered by exudate in the lower anterior chamber angle. The particle was subsequently removed and the eye quieted down.

**CASE 2.** J.B. Auto repairman, aged 34 years, referred with 24 hour old perforation of his left eye by a piece of wire. Examination revealed a left corneal perforation in the pupil zone with swollen traumatic cataract bulging into the anterior chamber.

Vision of the right eye was 20/35. Slit-lamp examination of that eye revealed early siderosis and a healed lumbis perforation. X ray examination of both eyes located a small irregular metal splinter in the right ciliary body. The left eye was negative roentgenologically.

Further questioning revealed a history of injury 9 months previous while working on another job. The first aid attendant and the plant surgeon found no foreign body at that time and since there was no pain and very little redness the eye was dismissed as negative at that time.

The examination gave evidence of a distinct injury involving both eyes: the fresh perforation of the left eye without foreign body; a forgotten injury of the right eye (proved to harbor a small steel splinter). A magnet extraction was performed by the anterior route on the right eye. The left eye was atropinized and watched for several days after which a linear cataract extraction was performed.

#### ROENTGENOGRAPHY AND LOCALIZATION

With the clinical examination completed one proceeds to x ray examination and localization. Accurate localization is the *sine qua non* for the proper management of intraocular foreign bodies. It is best to look up a roentgenologist who takes special interest in foreign body localization. It is good policy for the ophthalmologist to be thoroughly familiar with x ray foreign body localization. He should be

able to supervise the localization and he should be able to suggest variations in the technique so as to determine whether a fragment is in or just outside the eyeball. Glass (unless containing lead) wood and many other substances are not opaque to x rays. Metallic and stone splinters are x ray opaque. But a minute foreign body can be overlooked. Sometimes artefact shadows are produced by imperfect screens. Because of this it has been our practice to advise first qualitative study by (a) stereo-x ray in posteroanterior view with patient's chin and nose resting on the x ray cassette (b) lateral stereo of the affected eye, (c) skeleton free (soft tissue) technique of Vogt (28-29) for minute fragments in the anterior segment (see Figs. 1-2). The latter is performed by pressing the corner edge of a dental film into the inner canthus and shooting across from the temporal side with the central x ray beam (soft ray). This can be done with the eye looking successively in various directions namely up straight ahead down abducted and adducted as necessary. This exposes all portions of the anterior segment. The eyelids may be pulled out of the way by adhesive strips. A small metal marker attached to the upper and lower limbus at 12 and 6 o'clock helps orientation. Proptosis produced by injecting retrobulbarly 2 to 4 cubic centimeters of 2 per cent procaine aids in exposing more of the globe to this skeleton free soft tissue technique. Thus, some substances such as glass or minute metal splinters, which would be obscured by bone shadows and would not show up by the usual technique, become visible by Vogt's method.

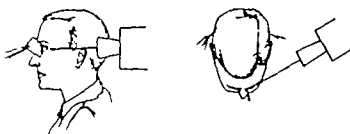


Fig. 2. Vogt's skeleton free x ray technique for localization of foreign bodies in the anterior segment of the globe. Plate-tube distance 30 inches equals 75 centimeters.

*Localization* is readily performed by Comberg's method (2-12). This method is simple and accurate when properly applied. It is foolproof for it indicates automatically voluntary or involuntary rotation of the eyeball away from the desired position.

A drop of 0.5 per cent pontocaine is instilled in the conjunctival sac.

A contact lens with 4 lead markers on the limbal sclera is inserted beneath the eyelids so that the raised portion fits over the cornea. The lens is rotated so that the lead markers are at, or nearly at the 3, 6, 9 and 12 o'clock meridians.

First a posteroanterior exposure is made with the patient in prone position (chin and nose resting on cassette to throw the petrous pyramid shadow below the orbit) (Figs. 4-6). The patient looks straight ahead so as to see a reflection of his uninjured eye in the cassette or in a small pocket mirror lying on the cassette before the uninjured eye (Fig. 4a). The central ray (perpendicular to the plate) is aligned with the anteroposterior (visual) axis of the globe. In the presence of strabismus a thin

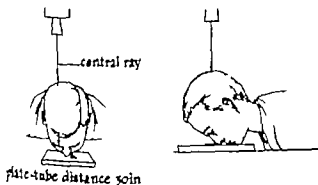


Fig. 3.

Fig. 4.

Figs. 3, 4, 4a, 5. Modified Comberg localization technique with contact lens. Central ray is over the injured eye.

Figures 3, 4, and 4a show method of taking posteroanterior

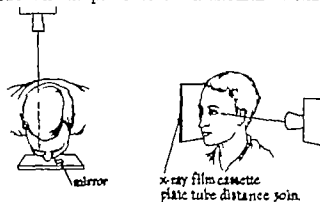


Fig. 4a.

Fig. 5.

exposure in chin nose position. Uninjured eye looks into fixation mirror. Figure 5 shows method of lateral exposure. Injured eye is next to plate. Central ray passes through limbus. Plate-tube distance 30.

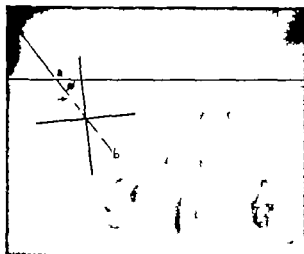


Fig. 6



Fig. 7

Fig. 6 X-ray localization posteroanterior view (chinose position petrous pyramid projected below orbit). Contact lens with lead markers in position. Foreign body is shown by arrow.  $c$  is corneal center located by drawing diagonals between markers. Line  $ab$  drawn through foreign body and corneal center makes angle  $\phi$  with horizontal orbit line.

Fig. 7 X-ray localization lateral exposure. Glass localizing contact lens with lead markers resting on globe. Arrow marks foreign body. Measurements along line  $cd$  gives distance of particle behind limbus. Correction factor due to x-ray distortion in Figures 6 and 7 is 10 per cent.

cover glass mounted on a black cardboard triangular wedge is used as an angle mirror to reflect a pocket flash light into the noninjured left fixating eye (Fig. 3). The light is held so that the visual axis of the injured right eye is perpendicular to the x-ray plate. The central ray must pass coaxially with the visual line of the injured eye. If one-eyed the patient is instructed to look at the reflection of his eye in the polished cassette surface. If this is not possible due to low visual acuity the angled cardboard mirror and flash light are employed before the only eye. Then a lateral exposure is made with the patient lying on the affected side and looking straight ahead at a mark on the opposite wall. The central ray should pass through the limbal plane bisecting the cornea (Figs. 5-7).

The measurements taken from the posteroanterior and lateral views are corrected for distortion by reducing them by 10 per cent. They are then plotted on Comberg's localization chart (Fig. 8). In the posteroanterior view (Fig. 6) the lead dot shadows are connected diagonally by lines scratched on the x-ray plate to give the center of the cornea. A line,  $ab$ , drawn through the foreign body and the corneal center  $c$  makes angle  $\phi$  with a line

drawn parallel with the roofs of both orbits. The angle is measured with a protractor and transferred to the localization chart (Fig. 8)—and is shown to correspond with the 120 degree meridian. The distance from foreign body to visual axis on x-ray plate (Fig. 6) corrected for x-ray distortion by 10 per cent is plotted on this circular front view.

From the lateral exposure (Fig. 7) one determines the distance of the foreign body from the limbal plane along the line,  $cd$ . The anterior and posterior limits, 13.8 millimeters and 16.6 millimeters respectively are plotted on the meridional section of the eye through the 120 degree meridian. The radial distance—foreign body to posteroanterior axis—is taken from (Fig. 6) as plotted on (Fig. 8a) and is again plotted on (Fig. 8b). This corresponds with its position in the upper temporal quadrant of the posterior vitreous. One can readily realize that a movement of the globe would be shown by a corresponding change in position of the localizing shell. (Figs. 6 and 7 show exposures with a glass contact lens.)

There are several objections to the Comberg contact lens. It does not always lie centered on the cornea and being made of glass can break on falling.

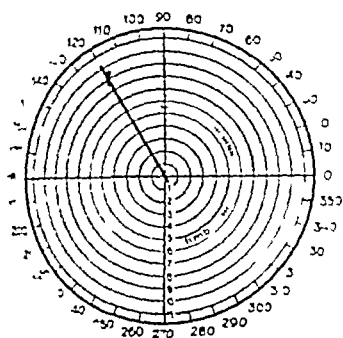


Fig. 4. Localization diagram at left a front view of the eye.

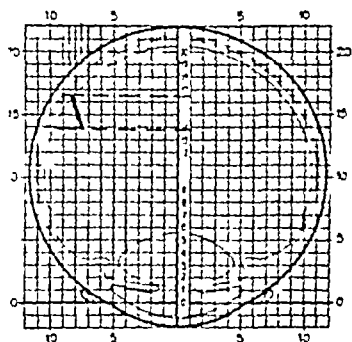


Fig. 5. Localization diagram at right a front view of the eye.

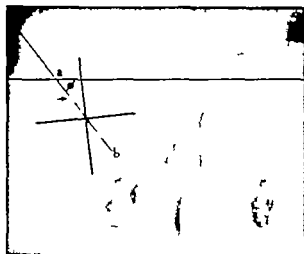


Fig. 6.



Fig. 7

Fig. 6. X-ray localization posteroanterior view (chin nose position petrous pyramid projected below orbit). Contact lens with lead markers in position. Foreign body is shown by arrow.  $c$  is corneal center located by drawing diagonals between markers. Line  $ab$  drawn through foreign body and corneal center makes angle  $\phi$  with horizontal orbit line.

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be done by such methods. Nor are such tests conclusive. The magnet should be applied only in the operating room and then only after x ray localization. The sideroscope was in use in the latter part of the 19th century to determine the magnetic character of foreign bodies. It was unreliable and fell into disuse.

Since 1943 I found the Berman locator especially valuable in determining whether an intraocular foreign body is magnetic or nonmagnetic. It has been useful in locating and pinpointing the spot on the sclera closest to the magnetic fragment. It has served as a check on x ray localization (which is usually correct and occasionally faulty). It has made possible the determination as to whether the fragment has actually moved after magnet application. It has helped me to decide whether the giant magnet or the hand magnet was necessary for extraction of a foreign body. It has served as a psychological comfort throughout the operative procedure. It was first used by Moorhead at Pearl Harbor in 1941. Minsky published the first recorded application of the locator for the transscleral removal of an intraocular foreign body. So far it has not aided in localizing small nonmagnetic fragments.

#### JUDGMENT AS TO PROCEDURE

Having determined the character and having localized the foreign body, having determined the absence or presence and extent of infection, having arrived at some conclusions as to the amount of ocular trauma and having come to the conclusion that some measure of vision can be saved, one asks himself: which foreign bodies should be removed and which might best be left undisturbed?

Chemically inert substances such as glass and stainless steel do not cause ocular irritation as a rule. Aluminum is also well tolerated. On the other hand, brass, copper, zinc and their alloys, iron and steel produce ocular inflammation and deterioration. One must use careful considerate judgment in deciding on operative interference.

Prompt removal of an intraocular foreign body before it sets up too much irritation or infection and before it becomes surrounded by exudate is essential. It is wise to attempt the removal of all irritating nonmagnetic foreign

bodies, if one can avoid excessive mutilation of the globe in doing so. Prompt and early surgery followed by a well considered plan of procedure should be the rule. The surgeon with all facts at hand decides whether operative interference or conservative treatment is to be followed. Should surgery seriously threaten the integrity of the eyeball and prove to be mutilating or destructive, then one must realize that nothing is to be gained by performing an operation.

#### COMBATING INFECTION—PROPHYLAXIS

Every early foreign body case, when first seen, must be considered as potentially infected. To combat such infection and before any organism can be isolated, the surgeon must rely on prophylactic measures. Since the days of Wagner Jauregg's malaria treatment of syphilis, ophthalmologists have found that foreign protein therapy in the form of 15 to 30 million typhoid bacilli antigen intravenously or 10 cubic centimeters of boiled milk intragluteally are helpful in controlling intraocular inflammation. On admission 1500 units of antitetanic serum is given. Penicillin—100,000 units—is given intramuscularly as an initial dose and is repeated in 50,000 unit doses every 3 hours for 4 to 6 days. We have also found subconjunctival infection of 500 units of penicillin dissolved in 0.5 cubic centimeter normal saline to be helpful.

*Sulfadiazine* has been especially valuable in our experience in combating infection. Six grams are given during the first 24 hours beginning with a 2 gram dose. Four grams are then given daily in divided doses for another 48 hours. Thereafter 2 grams are given every 24 hours for 5 days. A blood level of 8 to 10 milligrams is desirable. The urine must be watched for sulfa crystals. The blood must be watched for leukopenia and anemia.

#### PREOPERATIVE CARE

As preparation for local anesthesia, pentobarbital 0.1 gram is given 1 hour before operation. The skin is scrubbed with soap, irrigated and painted with 3% per cent tincture of iodine or merthiolate.

Local anesthesia is performed in the following manner:

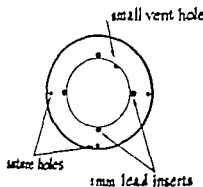


Fig. 9.

Fig. 9. Modified Comberg localizing shell made of plastic or glass. It may be anchored to episclera at 3 suture holes.

Fig. 10. Author's corneal splinter forceps. a, General view of entire forceps, b, enlarged view showing sharp

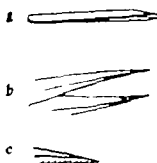


Fig. 10

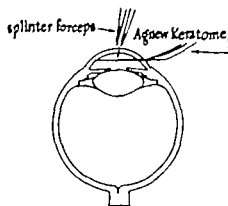


Fig. 11.

points and serrations on blade, c, lateral view illustrating backward pointing serrations. They afford a strong grasp

Fig. 11. Kuhnt's method of removing penetrating corneal splinter pupil zone, aided by use of forceps.

1. Pontocaine hydrochloride 0.5 per cent is instilled topically 3 drops at 1 minute intervals.

2. Procaine 2 per cent with 1:30,000 epinephrine is injected into the lateral canthus subconjunctivally and into the superior rectus tendon.

3. Akinesia is performed by injecting 5 cubic centimeters of 2 per cent procaine, containing 1 minim of 1:1000 epinephrine 10 to 15 millimeters above the incisura intertragica (ear notch).

4. Retrobulbar injection consists of 0.5 cubic centimeter solution, containing cocaine hydrochloride 1 per cent, procaine 2 per cent, epinephrine 1:30,000.<sup>1</sup>

#### CORNEAL FOREIGN BODIES

Superficial foreign bodies may be wiped off with a moistened cotton applicator after topical anesthesia. Imbedded particles are dislodged with a sharp spud used to pry up the edge of the fragment. Multiple imbedded foreign bodies are readily removed with the 1 millimeter curet.

The narrow beam of the slit lamp microscope is invaluable in ascertaining the depth of a corneal foreign body. It readily affords information as to whether a particle is wholly intracorneal or projects into the anterior chamber. Metallic shivers or wooden splinters between the corneal lamellae are removed by dissecting down on them and then prying them

<sup>1</sup>To prepare procaine 2% with 1:30,000 epinephrine, add 1 minims of 1:1000 epinephrine solution to c.c. of 2% procaine solution.

up with a cataract knife. When somewhat dislodged the splinter is grasped with the author's corneal splinter forceps (22) (Fig. 10). This forceps has fine rasped teeth which point backward and provide an excellent hold. Thorns and wood splinters are likely to cause keratitis if removed incompletely. On the other hand small glass spicules or coal particles or powder particles if wholly intracorneal may be left undisturbed since they rarely irritate.

The more troublesome corneal foreign bodies are the ones penetrating to or into the anterior chamber. There is always danger of pushing them into the chamber, also the hazard of producing traumatic cataract if the projecting fragment strikes the lens capsule.

Penetrating corneal foreign bodies in the pupillary zone are best removed by the method suggested by Kuhnt many years ago (Fig. 11). Pilocarpine is used to contract the pupil. A narrow keratome (4 mm. wide) such as that of Agnew or of Castroviejo is introduced through the cornea and the point anchored on the other side. The keratome blade thus lies beneath the foreign body. One now dissects the corneal layers down to the foreign body and removes the fragment with the splinter forceps. The keratome is now withdrawn and the pupil is dilated with atropine. The anterior chamber is restored with normal saline to avoid anterior iris synechia.

A penetrating splinter in the periphery is removed after making a corneal flap inserting 1 or 2 interrupted sutures (Fig. 12). The flap is lifted and the foreign body is removed with





Fig. 2.

Fig. 12. Limbal incision and preplaced sutures for removing peripheral placed penetrating corneal splinter.

Fig. 3. Second step in removal of splinter from everted cornea with forceps.

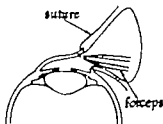


Fig. 13.

forceps from within (Fig. 13). It may be necessary to pry the splinter loose with a knife needle.

Another method for removing deep corneal foreign bodies is to make pressure from inside with a small Reverdin needle (inserted through a keratome incision) against the posterior surface of the cornea while cutting down onto the foreign body (Fig. 15).

#### FOREIGN BODIES IN THE ANTERIOR CHAMBER

Magnetic particles in the anterior chamber rarely require the insertion of an instrument into the globe, except for toilet of the wound. On the other hand, the nonmagnetic fragment must depend on special forceps: a blunt iris hook, and an Elschnig spatula for its removal. Small particles of glass, coal, inert solids, and rootless lashes do not as a rule require surgery. Copper and brass must be removed.

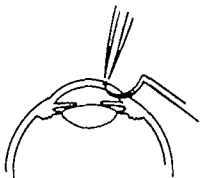


Fig. 15. Use of Reverdin needle through keratome incision to press foreign body backward through cornea while extraction is attempted from without.

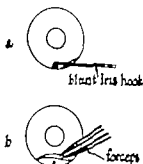


Fig. 14.

Fig. 14. a, Use of blunt iris hook to dislodge fragment wedged in chamber angle. Final removal with forceps. b, Forward incision in cornea permitting access into chamber angle.

It has been our practice to use the Berman locator in every case, and on occasion we found an intraocular foreign body to be magnetic, when the history suggested otherwise. The penetrating corneal foreign body is at times pushed into the anterior chamber and then it is obviously handled as such.

For the operation one should have at hand the usual iridectomy instruments, plus serrated curved anterior chamber clot forceps, Arruga's capsule forceps, the author's corneal splinter forceps, Tyrrel's blunt iris hook, Elschnig's cyclodialysis spatula, and an anterior chamber irrigator. It should be a rule to fill the anterior chamber with normal saline at the end of the operation. Hyphema should be allowed to absorb or must be irrigated away before removal can be attempted.

Nonmagnetic foreign bodies not enmeshed in iris tissue are readily grasped and removed with one of the above special forceps through a properly placed keratotomy. It is best to avoid the wound of entry unless it is large. The corneal incision should be posterior to the foreign body so that the rear wound lip will not interfere with instrumentation. The particle should be grasped so that it will not dart away. The lens capsule must be avoided. After removal of the fragment, any iris prolapse that may be present is replaced, the chamber is then restored with saline and in most cases it is advisable to close the incision with atraumatic silk sutures. This prevents postoperative iris prolapse. No atropine is instilled at this time. A binocular occlusive dressing is applied. After 3 or 4 days, 2 per

carried out under direct vision with greater ease; (2) it is possible to ligate the main gastric artery at its exact origin from the celiac axis, thus insuring complete lymph node excision; (3) it enables the surgeon to resect the tail of the pancreas and the spleen if this becomes necessary; (6) it shortens considerably the operative time, which is a desirable feature; (5) should a total gastrectomy become necessary, the visualization of the jejunal blood supply and the performance of the esophagojejunal anastomosis are made more easily.

After the necessary anastomosis has been effected, the incision is closed layer by layer. The diaphragm is repaired with interrupted silk sutures and the enlarged opening is sewn to the transplanted stomach. Before the chest wound is closed, a rubber tube is inserted in the 9th interspace for underwater drainage. The costal arch is repaired by approximating the cartilages with chromic catgut. Before the abdominal incision is closed, a Witzel jejunostomy is done for feeding purposes. A properly applied snug dressing completes the operation.

The relative comfort of these patients as compared with those who have had rib cutting and rib excision operations is very impressive. It seems to me that the postoperative course is smoother and more rapid. We have, up to the present writing, employed this incision on fourteen occasions and have become more impressed with each succeeding case. I believe that its more general adoption will simplify considerably the problem of carcinoma of the cardia and lower esophagus.

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# THE PROBLEM OF STRESS INCONTINENCE AND ITS SURGICAL RELIEF

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THE past fifty years has witnessed a very full development of specialization in medicine. Among the fields which have tended to become separated in the process are those of urology and gynecology, so that many present day gynecologists have little or no experience in urological problems; the average urologist is in no better position in regard to gynecology. This situation is unfortunate since the bulk of urologic disorders peculiar to the female are fundamentally due to gynecological factors. Occupying a prominent place among such urological conditions is the symptom of stress incontinence due to urethrocele. The fact that this condition lies at the border line between two specialties may account for the common lack of understanding of its nature and to the slow progress of its surgical relief.

Stress incontinence in the female, under conditions which raise intra-abdominal pressure, such as sneezing, coughing, lifting heavy weights, or, in extreme cases, any exertion, is a common gynecological symptom. In most instances it is of occasional occurrence and can be considered only a minor annoyance. Under these conditions most patients conceal this symptom and admit to it only under direct questioning (20). In a minority the symptoms develop to such a degree that the patient, on the slightest exertion, discharges a large amount of urine. Such patients are continent only when lying down or sitting quietly; their disability, therefore, becomes a subject of major complaint. It is with this extreme degree of incontinence that this report is chiefly concerned, particularly if previous efforts at surgical cure have resulted in failure.

Reference to gynecological texts of the late nineteenth century reveal that this condition, then termed passive incontinence, was regarded as most difficult of relief (13). Prom-

inent in the treatment was a varied and wholly irrational group of drugs, as well as different types of physiotherapy. Surgery was mentioned as a possible treatment with the very faint recommendation that it was usually unsuccessful. Dudley (4), in his presidential address entitled "Incontinence in Women" before the American Gynecological Society in 1905, summarizes the therapeutic knowledge of a somewhat later period. He mentions four main types of treatment: (1) injection of paraffin in the region of the urethra; (2) massage and electricity; (3) torsion of the urethra ( $180^{\circ}$ - $450^{\circ}$ ) as advocated by Gersuny; and (4) advancement of the external urethral orifice, advocated by Pawlik, Hemmelfarb, Al-berran, and others. He condemned the first three forms of treatment as being useless or dangerous, but saw some merit in the last, describing an advancement operation which he himself had devised. It is of interest in this regard that Berkow recommended advancement of the external urethral orifice as recently as 1941, reporting 17 cures in 21 cases, although it is difficult to see how such a procedure would restore an incompetent internal sphincter (2). In addition Murless reported successful results following the injection of sclerosing solutions about the urethra in 1938 (15); therefore, these old forms of treatment have not been completely abandoned. It is probable that the procedure advocated by Kelly in 1913 (4, 8) and utilized by him during the preceding 10 to 12 years, was the first operation directed at the cure of stress incontinence and practiced extensively in this country. The successful results of this technique, commonly known as the Kelly stitch and still widely used, were at first attributed to the tightening of a relaxed internal sphincter. Following the introduction of this operation, various modifications were developed, involving more extensive dissection and often plication of the dilated bladder neck and upper

urethra as well as the supporting fascia (3, 7, 20). The most recent of these operations, devised by Kennedy, includes a mobilization of the upper urethra by separation of the lateral fascial attachments from the pubis (10, 11, 12). During this period it was realized that the most important aim to be attained by surgery was the reapproximation of the fascial supports of the bladder neck so that this structure was held securely behind the symphysis (3, 20). When such a result was accomplished the previously atonic sphincter regained its tone and once more became competent. Unless support was attained the bladder neck and upper urethra would once more prolapse to form a urethrocele, and the incontinence would recur because of the consequent loss of sphincter tone.

While successful results are attained, in a majority of instances, by utilizing the residual tissues—particularly if the incontinence is of slight degree—all operators report failures. These range from 20 per cent, as reported by Kelly (9), to the recent figure of 7.1 per cent reported by Kennedy (12). While no accurate figures can be reported, it is believed that the percentage of failures in our own clinic fall somewhere between these figures. Once a failure has occurred further operations of the same type are apt to be unsuccessful. This tendency may be illustrated by one of the cases about to be reported:

No. 8523-43 Mrs. J. V., aged 38 years, tripara, quadrigravida, was admitted to the gynecological service, Bellevue Hospital, on February 20, 1943, for the fifth time, with a chief complaint of stress incontinence. In her first pregnancy in 1924 she was delivered by forceps at home after a labor of 5 days. Her symptoms date from this event. Full term pregnancies occurred in 1927 and 1933, and a 3 month spontaneous abortion in 1935. She first sought surgical relief for her incontinence in 1930. At this time a diagnosis of cystocele, relaxed vesicle sphincter and relaxed perineum was made. The cystocele was repaired, the Kelly technique was employed to tighten the vesicle sphincter, and a perineorrhaphy was performed. No improvement in the incontinence occurred although her pelvic supports were adequately restored. In 1933 a second attempt to control the symptom was made, utilizing the same procedure except that perineorrhaphy was found to be unnecessary. Again complete failure was the result. In 1940 a third attempt was made utilizing the technique described by Kennedy. Again, failure was the result. Six months later, in the same year, a

fourth attempt was made to help her by the implantation of a strip of fascia lata under the bladder neck. No noticeable improvement followed.

Results such as this frequently cause the gynecologist to assume the attitude that nothing further can be done to relieve the patient.

Today the problem of urethrocele with stress incontinence lies in the surgical relief of patients who have experienced operative failures and in the avoidance of such failures. If the facts underlying this condition are correct there are three possible explanations for these failures: first, that the operative procedure has been inadequate; second, that the healing process has been imperfect due to infection or faulty blood supply; and third, that the supporting tissues have once more given way under the continued assault of intra-abdominal pressure. The first explanation often can be discarded since failures occur in the hands of experienced operators using procedures which appear fundamentally correct. Of the second and third explanations the last appears the most likely since serious infection is rarely seen in operations on the anterior vaginal wall, and in most failures temporary relief is obtained only to be followed by a recurrence of the condition.

Since the last supposition appears to be the explanation of most failures the reinforcement of the residual fascia by transplanted tissue would seem to be a possible answer to the problem. Such an attempt has been made by several gynecologists, utilizing muscle and fascia from several sources. The best known of these operations is that termed the Goebell-Frangenheim-Stoeckel procedure, in which, following a plastic repair of the bladder neck, strips of rectus fascia and underlying muscle are transplanted behind it (5, 6, 16). This operation never has been performed widely in this country. Others have reinforced the lower urethra with transplanted tissue (14, 19), although such a procedure would not be expected to have favorable results. Interest in the value of fascial reinforcement was stimulated by the report of Aldridge in 1942 on the use of transplanted strips obtained from the aponeurosis of the oblique muscles in combination with a plastic operation on the upper

urethra and bladder neck (1). He had obtained complete relief in a patient with stress incontinence who had been operated upon twice previously without success. Since then he has obtained favorable results in several similar cases.

Impressed by the result reported by Aldridge, a study of the application of this principle was undertaken. Since 1943 transplanted abdominal fascia has been utilized in a group of 44 patients to reinforce the repaired supports of the bladder neck and upper urethra. Thirteen of these cases have already been reported (17, 18). The present report includes this group and an additional 31 cases since operated upon. The etiological factors may be summarized as follows: There were 2 cases of congenital origin, 1 not influenced by full term delivery but suffering from congenital lues, and the other made worse by full term delivery. There were 25 cases of traumatic origin. Of these 16 cases were immediate, within 2 years of delivery and 9 were remote, more than 2 years after delivery but under the age of 40 years. There were 16 cases of traumatic and involutional origin—10 cases at time of menopause and 6 cases remote from menopause. Only 1 case was of purely involutional origin, a nullipara aged 70 years. That urethrocele may be of congenital origin is not commonly realized. The available labor records were reviewed, and it was found that a surprising number of the preceding deliveries had taken place without obvious injury. Often great care had been expended to preserve the perineum. This fact suggests that the forward projection of the presenting part in the second stage by the intact perineum often may be the traumatic agent. If this is true, the performance of an adequate episiotomy should obviate the occurrence of such an injury.

The most frequent lesion found on examination was the uncomplicated urethrocele which was present in 25 patients. This finding was mainly due to the large proportion of patients in this group who had undergone previous plastic operations (13 cases) with otherwise satisfactory results. Particular attention should be called to the group of patients who, in addition to urinary incontinence, showed indications for pelvic surgery. In 9 cases the

urethrocele was complicated by additional forms of relaxation, in 1 case 2 previous operations had failed to relieve the incontinence and in 8 cases there had been no previous surgery. In 10 other cases the urethrocele was complicated by additional forms of relaxation and by indications for hysterectomy. In 2 of these, 3 previous operations had failed to relieve the incontinence and in 8 cases no previous surgery had been performed.

Some may quarrel with the use of this procedure in so many primary cases. It can only be stated that in each instance there appeared to be a factor that made the possibility of failure by other methods seem likely. Among such factors were the age, the extent of the relaxation, and the character of the residual pubocervical fascia. For example, in this group was a nullipara, aged 69 years, with marked stress incontinence of 1 year's duration and a well developed urethrocele; also a 31 year old woman with a large urethrocele, apparently of congenital origin, who had suffered from incapacitating stress incontinence during her entire life. In the group requiring abdominal surgery, it was a matter of few moments to add the fascial reinforcement to the plastic operation previously performed.

In 15 of these patients the procedure described by Aldridge was used in a slightly modified form. Follow-up has revealed successful results in 11, but failures have resulted after a brief interval in 4 cases, accompanied, in each instance, by a recurrence of the urethrocele. Nevertheless the relief of most of these patients, most of whom had experienced one or more previous operative failures, was convincing evidence that the underlying principle was correct.

Experience with the Aldridge technique has shown several disadvantages. It involves (a) two changes in position; (b) the simultaneous performance of abdominal and vaginal operators, and because of these complexities (c) an increased opportunity for lapses in surgical asepsis. Most important, there appeared to be no way to fit accurately the fascial strip to the bladder neck. Frequently, because of shortness the strips had to be brought together under marked tension. In spite of the latter defect, union took place in

some patients quite unexpectedly. In others separation of the strips is suspected as the cause of the subsequent failure. The final disadvantage lay in the fact that the procedure was awkward to utilize if indications for reinforcement of the residual fascia was discovered unexpectedly at the time of a plastic operation on the bladder neck.

Because of these defects this type of operation was abandoned and another technique was adopted. This has been used on 30 patients, including 1 in whom a failure had resulted from the modified Aldridge procedure. It may be described as follows.

#### TECHNIQUE

The patient is put in the lithotomy position, prepared, and draped. The labia minora are retracted laterally by means of stay sutures. A weighted speculum is placed in the vagina thus exposing the lower anterior vaginal wall. In many of these patients previous operative procedures have resulted in adequate support to the portion of the bladder adjacent to the upper vagina and cervix. As a result of the previous perineorrhaphy the cervix may be difficult to draw down or expose. Since the necessary dissection is about the upper urethra and bladder neck, such exposure is not necessary. The anterior vaginal wall is seized with two Allis clamps, placed as far lateral from the midline as possible and at as high a level as can be attained. A third Allis clamp is placed in the midline about 1 centimeter from the urethral orifice. The scars of one or more previous operations can often be seen on the anterior vaginal wall (Fig. 1). The vagina is held tense by lateral traction on the first pair of clamps and a transverse incision is made between them through the depth of the wall. Scissor dissection at the lateral portion of this incision defines the plane between the bladder and the lower anterior vaginal wall, following which the scar in the midline can be divided without any risk of injury to the bladder neck or urethra. The lower anterior vaginal wall is then divided in the midline at right angles to the first incision. The edge of the vaginal wall on each side is seized by Allis clamps. Traction downward on these clamps and traction upward on the

clamp placed near the urethral orifice aids greatly in freeing the vaginal wall from the urethra and in making this incision. It should be carried to a point about 1 centimeter from the urethral orifice. The upper anterior vaginal wall can then be freed for a distance of 1 to 2 centimeters from the bladder and incised in the midline, Allis clamps being placed on the edge of the freed wall. The combined incisions result in the exposure of a diamond shaped area under which lie the upper urethra and bladder neck. The plane of the supporting fascia of the upper urethra and bladder neck is then identified, a varying amount of sharp dissection being necessary (Fig. 2).

Once found, the plane of separation along the outer aspect of this fascia can usually be followed by blunt dissection with the finger outward and upward to its line of attachment along the inner aspect of the superior pubic ramus (Fig. 3). Moderate pressure at this point with the finger results in rupture of the attachment allowing the finger to enter the space of Retzius. Occasionally penetration of the lateral part of the fascia must be accomplished by scissors. This dissection is carried out on each side. The bladder neck and upper urethra are thus fully mobilized. Considerable bleeding may accompany the latter stages of the dissection due to rupture of veins about the bladder neck. Since the source of bleeding is inaccessible it is fortunate that it invariably ceases spontaneously after a short interval. The supporting fascia of the upper vagina and bladder neck is then plicated by means of interrupted mattress sutures. The number of sutures required varies from one to three. This results in an elevation of the bladder neck behind the symphysis and a consequent lengthening of the urethra. A Penrose drain, measuring at least 30 centimeters in length, is then placed with uterine forceps so that an end lies in the space of Retzius on each side of the bladder, the midpoint of the thin tubing lying just underneath the bladder neck (Fig. 4). The excess vaginal mucosa is then excised in the form of four triangles, the tissue traumatized during the operation being removed. The vaginal wall is then closed with interrupted sutures from below upward, taking great care not to in-

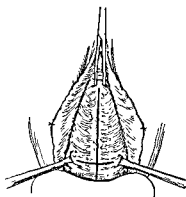


Fig. 1

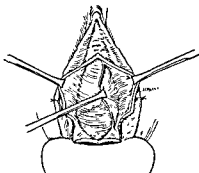


Fig. 2

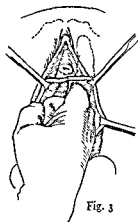


Fig. 3

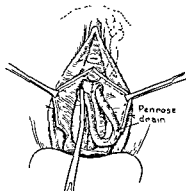


Fig. 4

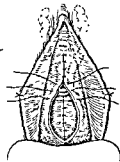


Fig. 5

Fig. 1. Vaginal wall held taut by Allis clamps. Incision outlined. The vaginal wall below the transverse incision is first freed from the underlying structures and incised vertically. The vaginal wall above this incision is then freed and incised vertically.

Fig. 2. Vaginal incision completed. The plane between the pubocervical fascia and the vaginal wall has been defined by sharp dissection.

Fig. 3. The plane between the pubocervical fascia and vaginal wall has been followed upward and laterally to the pubic attachment by means of blunt finger dissection. The lateral fascial attachment is ruptured thus allowing the finger to enter the space of Retzius lateral to the bladder neck.

Fig. 4. The pubocervical fascia has been approximated in front of the bladder neck and upper urethra by means of interrupted mattress sutures. This elevates the bladder neck behind the symphysis and lengthens the urethra. As a result the bladder neck lies at a much higher level than is depicted in this drawing. One-half of a Penrose drain, 30 centimeters in length, has been placed in the space of Retzius on the left side. With a uterine forceps the operator is preparing to place the opposite half in the space of Retzius on the right side. The midpoint of the drain will be under the bladder neck when the tubing is fully in place.

Fig. 5. Four triangles of vaginal wall have been excised. The vaginal incision is closed with interrupted sutures, with care not to include any of the underlying tissue or the Penrose drain.

clude any of the underlying tissue or the drain itself. A self-retaining catheter is placed in the bladder (Fig. 5).

The patient is then put in the dorsal position, prepared with merthiolate and draped. A long suprapubic incision is made curving to the left of, and extending slightly above, the umbilicus, exposing the external rectus sheath (Fig. 6). The incision is then draped with towels and clips. The rectus sheath at the bottom of this incision is cleared of fat to a width of 1.5 centimeters. The sheath is then incised just to the right of the midline, the incision being carried across the midline and just to the left of the umbilicus in the upper part of the wound. The septum between the two sheaths is cut and the fascia is then freed from the inner margin of the left rectus muscle to a depth corresponding to the area cleared of

fat on its external surface. The length of such a strip has always been found to be more than sufficient. Too short a strip is a handicap which cannot be overcome. Great care must be taken in separating the rectus sheath from the underlying muscle at the lineae transversae, one of which is always found close to the umbilicus and sometimes another 2 to 3 centimeters below it. The muscle is closely attached to the sheath at these points and unless the separation is made carefully to break on moderate traction. At this point the peritoneum can be opened, and any necessary surgery can be accomplished. If a complete hysterectomy is performed the upper prevesical fascia can be tightened if necessary by interrupted sutures or by excising a V shaped portion of upper anterior vaginal wall and ap-

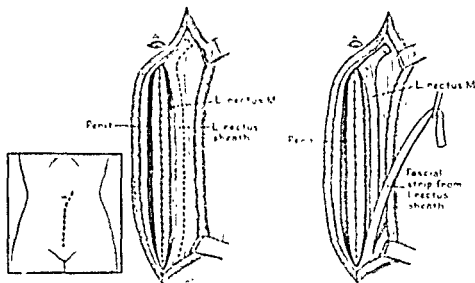


Fig. 6, left. Small inset shows character of skin incision. To left, the midline incision has been made just to right of midline. The external surface of the left rectus sheath has been cleared of fat and the septum between the sheath has been cut. The strip of fascia to be mobilized is outlined. The peritoneal incision has been closed following the completion of intra abdominal surgery.

Fig. 7. The fascial strip has been mobilized, its lower end being attached about 2 centimeters above the symphysis.

proximating the cut edges with interrupted sutures, as advocated by Meigs. The peritoneum is closed after the completion of the pelvic operation. The mobilized rectus sheath on the right side of the incision is then freed by cutting from above downward along the left margin of its cleared surface (Fig. 7). The lower end is left attached about a centimeter above the symphysis. One of the pyramidalis muscles is frequently left attached to its internal surface. The anterior wall of the bladder with its pad of fat can now be separated from the posterior aspect of the symphysis. The ends of the Penrose drain are easily located on each side of the bladder neck and are withdrawn from the lower angle of the wound (Fig. 8). Traction on either end is sufficient to make the drain move easily through the tunnel under the bladder neck. The end of the fascial strip is placed inside the open end of the left arm of the tubing and secured with a ligature. This step makes a smooth joint which will not catch on any tissue. Traction on the right arm of the drain carries the strip about the bladder neck and out of the lower angle of the incision. The strip can then be secured to the margin of the lower right rectus

sheath, by several interrupted sutures (Fig. 9). It should fit snugly about the bladder neck but should not be tight. The ligature securing the strip to the Penrose drain can now be cut, and the drain removed. The bellies of the rectus muscles are now approximated in the midline with three or four interrupted sutures. Several retention sutures are placed. The aponeurosis is carefully closed by two continuous sutures, one starting at the lower angle of the defect, the other at the upper. The two sutures meet at midportion of the incision where they are tied. The skin is closed with continuous dermal suture; a bolster is placed along the line of the incision, over which the retention sutures are tied. The use of sulfonamides in the wound has been abandoned.

After experience with both methods, it is believed that this procedure possesses definite advantages: (a) it is simpler, requiring only one change of position of the patient; (b) the plastic and abdominal surgery are consecutive and not simultaneous, reducing the number of assistants required; (c) breaks in aseptic technique are less likely to occur; (d) the fascial strip can be more accurately fitted to the



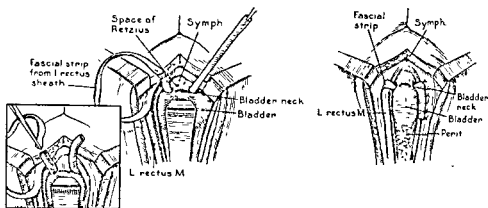


Fig. 8, Left. In inset, the bladder has been freed from the upper aspect of the symphysis. The ends of the Penrose drain have been located on each side of the bladder neck and have been delivered from the lower angle of the wound. The free end of the fascial strip is being introduced into the open end of the Penrose drain on the left. In the drawing proper the strip has been secured to the drain by a transfixion suture, thus forming a smooth joint. It is being drawn around the bladder neck by traction on the right arm of the drain.

Fig. 9. The free end of the strip has been sutured to the right rectus sheath by interrupted sutures, thus forming a sling under the bladder neck. This sling should be snug but not tense. The Penrose drain has been removed. The abdominal incision may now be closed, great care being taken with the lower angle

bladder neck; (e) the line of suture in the strip is remote from the undersurface of the bladder neck and at a point where all strain upon it from intra-abdominal pressure should be reduced by one-half; (f) any indicated lower abdominal or pelvic surgery can be carried out during the course of the operation; (g) it can be utilized without prior plan, if the residual supporting tissues are found to be attenuated during a plastic operation on the bladder neck.

#### POSTOPERATIVE CARE

After operation the patient is given 0.5 gram of sulfadiazine four times a day until the catheter is removed or until spontaneous voiding occurs. The catheter is irrigated once a day. It is removed on the ninth postoperative day, when the retention and skin sutures are taken out. No wound infections of major degree have been encountered. Two patients developed hematomas of the abdominal wound which required evacuation.

The resumption of normal voiding has been found to be much more delayed following this procedure than after the Aldridge type of operation. In the 15 patients operated upon by the latter technique 10 voided on the ninth day or before. Only 5 patients were unable to void following the removal of the catheter and

all were voiding normally by the fourteenth day. In the 29 patients upon whom the present technique was carried out (including 1 patient reoperated upon, and excluding 1 who developed a fistula) only 5 voided immediately following the removal of the catheter; 16 were voiding 1 to 5 days later; 5 went 6 to 11 days; while 3 took even longer, 1 of whom was successful 23 days after the removal of the catheter. Various measures were undertaken to hasten the return of normal urination but none were notably successful. Cystoscopic examination of one of the most protracted cases showed no distortion of the bladder; in another there appeared to be a moderately elevated bladder neck. Since all patients eventually regained their ability to empty their bladder normally it would appear that many of them, having existed with a hair-trigger mechanism, sometimes for years, took time to learn to void after the bladder neck had regained stability. This long delay in the recovery of normal bladder function in a few of these patients proved to be a disadvantage from the point of view of prolonged hospitalization and because these individuals became greatly disturbed because of their disability. These patients have been carefully followed. When successful results are attained,

the frequency and urgency of urination, often present 4 to 6 weeks after operation, disappear gradually. Usually no urinary symptoms are reported at the second visit which is made about 2 to 3 months later; the bladder neck is found tight behind the symphysis, with little or no descent on straining or coughing. When the bladder neck descends, incontinence will reappear and a failure result. Of the 15 patients operated upon with the modified Aldridge technique 11 (73+) have shown satisfactory results; 7 (46+) of them have been perfect, while 4 (26+) still experience occasional slight loss of urine on extreme effort. The latter patients are satisfied and are unwilling to undergo further surgery. With the present technique 27 (90%) successful results have been attained in 30 patients; only 1 (3+) of them states that she still has slight stress incontinence on extreme effort. Of the entire group 38 had total successful end-results, 86 per cent.

In regard to the failures, an opinion has already been expressed as to the defects of the procedure suggested by Aldridge. These are believed to be responsible for some of the failures following the use of this method. Of the 3 failures (10%) following the use of the present technique, 2 appear to be due to disruption of the reinforced support with recurrence of the urethrocele. One occurred because of a bladder neck fistula, caused by faulty dissection. Almost certainly the plane of cleavage between bladder and fascia was followed rather than the plane between fascia and vaginal wall. In addition the strip was pulled through the tunnel with narrow gauze packing which proved unsuitable because it caught in tissue. All of these errors can be avoided and should not recur if careful technique is followed. This fistula has been finally closed after one suprapubic and three vaginal operations, and it is regrettable to say that condition of the patient today is identical to her original state. One of the patients on whom the present technique was used developed a hernia of the lower angle of the abdominal incision. Extreme care must be used in the suture of this area because it is the most difficult part of the wound to bring into apposition.

The operative procedure described here is not presented with any idea of supplanting the widely used methods which employ a reconstruction of the original support of the bladder neck. The cases which have been described by no means represent the total number of patients with the symptom of stress incontinence operated upon during the same period. When the usual type of plastic procedure is employed an attempt is being made to predict its success or failure on the basis of age of the patient, degree of atrophy, the character of the residual pubocervical fascia, and the presence of factors producing excessive intra-abdominal pressure. It is only by learning how to make such an evaluation successfully that the failure of the usual plastic can be anticipated, thus avoiding the necessity of one or more secondary operations.

The results attained by reinforcing the reconstructed pubocervical fascia with transplanted abdominal fascia have not been free from failure. The majority of such failures have occurred during the evolution of an operative method. Most of them appear to be due to a defective technique rather than to an error in principle. The full technique, which has been described, has been utilized in the last 25 cases, successful results being attained in all patients with primary or recurrent urethroceles. The 2 failures both occurred in patients who had developed stress incontinence for the first time following the performance of extensive plastic operations. Four such patients were encountered in the entire group. No obvious explanation can be given for the difficulty in attaining a surgical cure in this type of case.

It is believed that the effectiveness of the procedure is dependent equally on a careful dissection and repair of the anterior pubocervical fascia and the support and reinforcement of this area by the fascial sling. The initial repair elevates the bladder neck behind the symphysis and restores the urethra to its normal length. The sling should increase the elevation of the bladder neck slightly, relieving the tension on the reunited pubocervical fascia; in healing it becomes incorporated in the pubocervical fascia, reinforcing the vulnerable area at which a recurrence of the

urethrocele can take place. It has been suggested that the sling causes a kink or stricture of the upper urethra, but no evidence of the latter has been found during postoperative catheterization or cystoscopy.

The permanence of the successful results can be determined only by prolonged follow-up. The first patient in whom the transplanted fascia was used was operated upon almost 3 years ago and shows a stabilized bladder neck with no tendency to descent. She is the patient whose history of four previous surgical failures has been quoted. It is to be hoped that the remainder show an equally good record.

#### SUMMARY AND CONCLUSIONS

1. The present day problem of the woman suffering from urethrocele and its accompanying symptom, stress incontinence, consists of:

a. The development of a method of surgical relief which will prove effective when simple plastic procedures have failed;

b. The evaluation of primary cases in regard to factors which may predispose to the failure of simple plastic procedures;

c. The use of a more effective operation in primary cases on the basis of such criteria, in order to anticipate failure by the simpler methods.

2. A surgical technique has been presented which it is hoped may solve this problem in some degree.

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## TWO HUNDRED AND FIVE CASES OF CANCER OF BREAST TREATED BY RADICAL MASTECTOMY

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MANY valuable studies of cancer of the breast have been reported by large clinics where the statistics are usually based on the collected experiences of many. This is a report of 205 cases of cancer of the breast in which radical mastectomy, management, and follow-up have been carried out by an individual. All of these cases are from private practice. In most instances the patients were first seen by the referring practitioner. There has been no selection of our cases. All cases with adequate records, proof of diagnosis, and good follow-up have been included.

This study serves to emphasize the necessity for early diagnosis as well as to point out other factors which may influence the final results. All diagnoses are based on the microscopic examination of paraffin sections of tissue removed from the involved breast. In no case was aspiration biopsy tissue used as a means of diagnosis. In the management of the cases complete histories were obtained and complete physical examinations were made. In some cases information on these points was furnished by the referring practitioner; consequently, in such cases additional history and physical examination relative to the breast only were obtained. If metastasis was suspected, a preoperative roentgenogram of the chest or a metastatic series was made. Preoperative roentgen therapy was used in selected cases, but this was not a routine procedure. In all cases the basis of treatment for this disease was radical mastectomy. Postoperative roentgen therapy employed immediately upon recovery was carried out as a routine. The patients have been followed by office visits every 4 months, at which time a

thorough history was taken and physical examination was made. Patients who had not visited the office for over 9 months were communicated with by telephone or correspondence. Simple mastectomies performed as a palliative measure for advanced carcinoma of the breast on elderly women, for foul smelling lesions, in severe cardiac disorders, and chronic debilitating lesions were not included in this series.

In this paper we wish to discuss the symptoms, physical examination, operability, treatment, pathology, irradiation therapy, metastatic lesions, and final results.

### SYMPTOMS

Table I enumerates the chief complaints or presenting symptoms noted. A lump in the breast was almost universally noted; in 88 per cent in our series. Many women complained of enlargement, swelling, soreness and pain in the breast. In most cases these findings were associated with a breast lump. Pain which attracts attention to so many conditions was present in only 31 cases. Sixteen women complained of discomfort in the breast. Pain in the breast occurring during the menstrual period is usually due to a benign condition. A stabbing, lancinating pain associated with a lump and slight tenderness frequently indicates that the lesion is a cyst. A dull ache or heavy feeling and discomfort may be due to a cancer. Pain in the breast may be due to pregnancy, mastodynia, abscess, mastitis, tuberculosis, involution, nipple disturbances and reflexly from pelvic pathology. There were 13 women who desired examination because of recent trauma to the breast. In all of these cases a malignant mass was discovered. It was felt that the trauma was coincidental and only served to focus attention upon the already diseased breast. Of course,

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TABLE I.—SYMPTOMS NOTED IN 205 CASES OF CANCER OF THE BREAST

Symptoms	Number	Per cent
Lump or mass in the breast	181	88.3
Enlargement or swelling of the breast	35	17.1
Pain in the breast	31	15.1
Soreness of breast	24	11.7
Discomfort in breast	16	7.8
Trauma to breast	13	6.3
Retraction of nipple	9	4.4
Discharge from nipple	9	4.4
Recent weight loss, more than 10 pounds	8	3.9
Annoying sensations in breast	6	2.9
Ulceration of skin of breast	4	2.0
Tenderness of breast	4	2.0
Itching of nipple	3	1.5
Itching of breast	2	1.0
Dimpling of skin of breast	2	1.0
Swollen arm	2	1.0
Eczema of the nipple and areola	1	0.5
Patients with two or more symptoms	104	50.7

we also have seen numerous traumatized breasts with no evidence of cancer.

Nipple discharges and crusting were mentioned by 9 women, one of whom tolerated the discharging nipple for 1 year. Eight women complained of rapid weight loss along with other more vague symptoms. Examination revealed a malignant breast tumor. There were 18 patients in this series who did not have breast symptoms or complaints. This is in conformity with the fact that early stages of infiltrating mammary cancer may be symptomless. There may be no pain, no discomfort, no enlargement of the breast. Therefore, the absence of tell-tale symptoms or the presence of a silent small, innocent-appearing lump in the breast must not lead us into false security. One hundred and four women presented two or more leading symptoms. The most frequent combination was a lump in the breast together with recent enlargement of the lump, pain or soreness.

Table II presents a time analysis of the 181 patients who complained of a lump or mass in the breast. Notwithstanding the seriousness of this, 36 of these women knowingly carried a lump in their breasts for 2 years or more without consulting a doctor; whereas, only 19 presented themselves for examination within a month after discovery of the breast tumor. On the other hand, an elderly woman had a breast lump 18 years and only because of

TABLE II.—LENGTH OF TIME THE LUMP HAS BEEN PRESENT IN THE BREAST—181 CASES

Lump in breast	Number	Per cent
Less than 1 month	19	10.5
One month to 2 months	40	22.1
Three to 6 months	26	14.4
Six to 9 months	35	19.3
Nine to 12 months	25	13.8
Two years	14	7.7
Over 2 years	22	12.2

recent rapid growth or enlargement of the lump did she consult a doctor. In 53.4 per cent a breast lump had been present longer than 6 months.

Even after we have discovered the breast tumor, either large or small, we cannot be certain of its age or extent of growth. We can be certain of the true nature of the tumor only by a microscopic examination after the tumor has been removed. Therefore, all tumors should be excised and microscopic study should be made to determine whether malignant change is present.

The knowledge of a breast condition was present in all these cases because the patients were either referred by practitioners or the patient was conscious of the breast condition herself. The fact that the lump had often been present in the breast for many months before treatment re-emphasizes the need for cancer education, for frequent periodical examination of the breast by the practitioner and for immediate pathological investigation.

Prognosis is definitely related to the presence or absence of glandular involvement, consequently, early diagnosis and early operation are most important. More than one-half the cases, 54.6 per cent, presented evidence of glandular metastasis at the time of operation. This is a high percentage of metastasis and it indicates that we are seeing some patients too late in the course of the disease to expect the best results from surgical treatment. Of these patients 62.9 per cent were between the ages of 40 and 59 years. Only 25.9 per cent were 60 years or more. The fourth decade was most frequently involved as well as the decade which had the highest percentage of metastatic involvement. In this series the fourth decade was the most vulnerable.

The 2 youngest patients were each 26 years of age.

TABLE III.—AGE DISTRIBUTION OF 205 CASES OF CANCER OF BREAST IN WHICH OPERATION WAS PERFORMED

Age	Number	Percent	With glandular involvement		Without glandular involvement	
			Number	Percent	Number	Percent
15 to 20	3	1.5	1	0.5	2	1.0
20 to 29	20	9.8	11	5.4	9	4.4
30 to 39	65	31.7	30	10.0	26	12.7
40 to 49	64	31.2	33	18.5	26	12.7
50 to 59	40	19.5	18	8.8	22	10.7
60 to 69	12	5.8	5	2.4	7	3.4
70 to 79	1	0.5	0	0	1	0.5
Total	205	100.0	112	54.6	91	45.4

One was a single girl with a massive painful tumor in the right upper quadrant of the right breast. A radical mastectomy was performed. The microscopic diagnosis was scirrhous carcinoma. There was no metastatic involvement of regional glands. She was given postoperative x-ray therapy to the breast and glandular regions (10 treatments to each of 4 portals). She was not castrated nor given hormonal therapy. She married within a year. She is well and in excellent health  $4\frac{1}{2}$  years after surgery.

The second girl was married and had 1 child 18 months of age.

She had a small, hard, painless nodule in the upper hemisphere of the left breast. Left radical mastectomy was done and the pathological microscopic report showed scirrhous carcinoma, duct cell type, without glandular involvement. She was given postoperative x-ray therapy to the breast and glandular regions. Ovarian function was not inhibited by surgery, roentgen ray, hormones, or other means. After  $4\frac{1}{2}$  years, she is well, in excellent health, and leading a normal life.

With regard to the position of the tumor in the breast, we found that well over 50 per cent were in the upper hemisphere and that the majority of these were in the upper outer quadrant of the breast.

The right breast was involved in 86 cases, 47.7 per cent. The left breast was involved in 94 cases, 52.3 per cent. The frequency of right or left breast involvement has no bearing upon the prognosis of the disease.

Complete information concerning hormonal therapy which patients may have received prior to mastectomy was not available.

Table IV shows that 78 per cent of our cases were married women and 21.4 per cent were

TABLE IV.—CANCER OF THE BREAST—205 CASES

	Percentage
Married—Multiparas . . . . .	65.0
Married—Nulliparas . . . . .	13.0
Single women . . . . .	21.4
Males . . . . .	.6

unmarried. There were 65 per cent who have borne children and 34.4 per cent who were childless. Complete information on lactation and nursing was not available. These figures are relative and not a true index of what can be expected in the population at large.

#### PHYSICAL EXAMINATION

A thorough history of the condition can be diagnostic or misleading. In itself a history is not sufficient. A physical examination of the breast must be done. There are no special types of patients nor special types of breasts with propensities for cancer of the breast. Cancer may occur anytime after puberty.

For the purpose of examining breasts a special room was set up. This includes a reclining chair which permits easy examination of the patient in various positions. A dark room permits transillumination and lighting for shadow effects. There are also facilities for aspirations, redressings, and so on.

The breast is first inspected with the patient exposed to the waist. One breast is always compared with the other as to appearance, size, shape, and regularity of outline. Any changes from the normal may be due to a pathological condition. Flattening, dimpling, or wrinkling of the skin may be brought out by oblique lighting, shadow effects, by having the patient raise her arms overhead while casting low intensity light across the breast. Restricted mobility of the mass or fixation to the skin is due to atrophy of overlying or surrounding fat and fibrous attachment of the mass to the skin, fascia, or underlying muscles. Retraction or elevation of the nipple to one side is suggestive of cancer. The condition of the nipple is observed. It may be crusting, ulcerated, or discharging. Discharges from the nipple may be bloody, serous, white and greenish. Microscopic examination from nipple discharges are made to determine if red blood cells are present. Chocolate colored discharges which sometimes occur in chronic

mastitis could be erroneously described as bleeding from the nipple. In papillary cystadenoma there may be a bloody discharge from the nipple resulting from an intracystic hemorrhage. A cystadenoma may be confused with a carcinoma because it occurs in the third and fourth decades. It is a hard, nodular, painless mass which is opaque to transilluminated light. It is movable and usually does not have the fixation of cancer. It is generally centrally located and feels deep within the breast on palpation, whereas, carcinoma feels superficial on palpation. Trauma to the breast may produce a hematoma with bloody discharge from the nipple simulating a tumor. In 13 cases of this series the trauma was to a pathological breast; consequently, nipple discharges could be misleading if it was assumed that the discharge was due only to trauma. In most cases, however, it is a normal breast which is traumatized. Bloody discharges may be due to a duct papilloma, duct cancer, or cancer starting in the acini. The bleeding is spontaneous and intermittent and associated with a hard, solid tumor. It may also be due to sarcoma, Paget's disease, cracked nipple and trauma. Discharges other than bloody are frequently seen in mastitis, abscess, involutional cysts and other conditions. Greenish discharges may be seen after lactation due to inspissated milk. A whitish discharge may be due to milk, pus, cysts, or malignant growth. Any discharge from the nipple may be serious, thus a careful examination of the breast and the discharge is necessary to determine the presence of a tumor. Often surgery will be required to determine the exact nature of the lesion.

Palpation may be done both with the flat of the hand and the tips of the fingers. Hard nodules which can best be appreciated with the flat of the hand are often scirrhus carcinoma. They may be fixed to the deep fascia and later to the skin. Local flattening or general shrinkage of the breast may be noted. Local flattening suggests cancer; whereas, focal prominence suggests a benign tumor or cyst. Slight dimpling of the skin due to lymphatic edema often occurs early. Changes in the position of the nipple or in the appearance of the skin overlaying the tumor are usually late signs in mammary cancer.

Involvement of the large milk ducts is responsible for fixation and later actual indrawing of the nipple. Retraction of the nipple is very suggestive of early duct cancer or advanced carcinoma elsewhere. Drainage from the nipple is rarely seen in early cancer.

Cysts are round, smooth, fluctuant, well circumscribed and not fixed. Fibroadenoma may be round, smooth, hard, and palpated best with the tips of the fingers. Cancer is hard, irregular, and adherent to neighboring tissue. Early deep abscesses of the breast can be confusing. There may be no elevation of temperature and only slight redness of the overlying skin. They may respond to chemotherapy or they may have to be incised and drained. The abscess gives the feeling of diffuse deep tumor. Undue manipulation, palpation, and squeezing of the breast does not aid in diagnosis and adds the danger of producing metastasis.

#### TRANSILLUMINATION

Normal tissue transilluminates well. Cysts filled with clear or cloudy fluid and small tumors transilluminate various degrees of light. Blood vessels, bleeding tumors in which there is usually a cyst filled with blood, are opaque to transilluminated light. Dilated ducts distended with inspissated secretions, thick walled cysts, solid tumor, carcinoma, and fibroadenomas over 2 centimeters in diameter will cast shadows. Small malignant or benign tumors may not cast a shadow. Breasts are best transilluminated with patient in the sitting position; however, other positions may yield more satisfactory results in some cases.

We have not used the roentgen-ray soft tissue technique for diagnostic purposes in breast lesions. In some cases the roentgenologists have carried out this procedure for their own edification. For our purposes we did not feel that these procedures have been sufficiently developed to justify clinical use, particularly when microscopic examination would be performed in any case.

In most cases of anticipated radical mastectomy a roentgenogram of the chest and skeleton was made to check for possible metastasis. The x-ray findings were considered in the determination of operability.

Aspiration biopsy, that is, the withdrawing of tissue for microscopic diagnosis, was not employed. It was felt that this was not an adequate procedure because the diagnosis was not always reliable. Aspiration of fluid in benign cystic conditions has been performed but is not considered in this paper.

#### OPERABILITY

In this series the types of lesions and the criteria of operability were as follows:

1. Any lesion of the breast which clinically appeared to be carcinoma and in which this diagnosis was confirmed by gross appearance and frozen section or the Terry stain.
2. Any cancer of the breast with or without axillary nodes unless the nodes were large and fixed to the surrounding tissue.
3. Any lesion which was freely movable from the thoracic wall regardless of ulceration.
4. Lesion which showed no evidence by roentgenogram of metastatic involvement of viscera or skeleton.
5. The chance of curing the patient or offering comfort and a greater length of life must be reasonably assured.

The pathological findings contraindicating operative treatment were:

1. Roentgenographic evidence of skeletal or visceral metastases.
2. A palpable, large, nodular liver.
3. Large growths which were fixed to the thoracic wall.
4. Extensive metastases to axillary lymph nodes, supraclavicular nodes and other regional nodes, and to other parts of the body.
5. Fixation of axillary glands with edema of the arm.
6. Signs indicating far advanced disease.
7. Skin metastasis beyond the area of the tumor.
8. Bilateral breast carcinoma.
9. Diffuse types of malignancy if at all advanced.

The decision to operate is a matter of experience and judgment. No arbitrary set of rules can be set forth and adhered to without flexibility. The justification has been found in patients who were considered hopeless but following operation have enjoyed many comfortable years.

#### TREATMENT

Every patient deserves the benefit of treatment. Although we have had no operative mortality we believe that no patient should be subjected to operative treatment, risk, and disfigurement without having the diagnosis definitely proved by a preoperative biopsy and microscopic examination. The final results of treatment will depend upon the extent of the lesion at the time of operation, the thoroughness with which the operation is performed and this includes axillary cleaning, the age of the patient, and the grade of malignancy.

Small lesions of the breast without glandular involvement are most favorable for treatment. Larger lesions with glandular involvement are less favorable. With the advance of metastasis we approach the inoperable stage.

Radical mastectomy followed by postoperative roentgen therapy was the basis of treatment in this series.

In selected cases preoperative roentgen therapy was used. In some instances it produced a false security. The tumor disappeared under the irradiation and the patient refused to proceed with surgery. Let us cite one such experience:

Mrs. E. A., a prominent and intelligent woman of 33 years, the mother of a 6 year old child came to us with the complaint of a lump of 2 years' duration, in her left breast. The mass was symptomless. About 2 months before her visit the mass became larger with a puckering or dimpling of the skin over it. Clinical examination revealed a hard, irregular, freely movable, superficial mass about 2 by 2 centimeters with orange-peel type of skin over the mass and fixed to the mass. The tumor was opaque to transilluminated light. There was a small freely movable, left axillary lymph node. A roentgenogram of the chest was negative. The clinical diagnosis was carcinoma of the left breast with axillary metastasis.

Under preoperative roentgen therapy, which was started the following day, the mammary tumor and axillary node disappeared. The roentgenologist stated: "We thought because of the small dose of x-ray necessary to bring this about that we were dealing with mastitis."

With the disappearance of the tumor the patient refused to proceed with surgery. She did consent to follow-up visits for about 1 year. Then she refused to submit to further observation because she considered herself cured. Within another year and less than 2 years from the time we first saw her, she had extensive metastasis to the bones. She was having much pain and great discomfort. The same roent-



genologist then stated "We are obviously dealing with a type of malignancy." It was now too late to give her any aid through surgery. She went right on to die.

Preoperative roentgen-ray therapy adds to the discomfort of the patient and produces a long delay before operative treatment can be instituted. It is often 4 to 6 weeks during which time metastasis may have its start. In some cases a pleuropulmonitis has been produced. A positive diagnosis of cancer cannot always be made, particularly in early cases. One is not sure what the true condition is. Alleged cures may not have been cures at all. Tolerance of the patient for additional irradiation may be unnecessarily lowered by giving treatments to unproved conditions thus hindering further postoperative treatment. If preoperative irradiation is to be undertaken after biopsy tissue of the tumor has been removed, the surgeon would do better to proceed with radical mastectomy rather than to close the incision, then to proceed with irradiation, and again later return to surgery.

To obtain biopsy material by incision the patient is prepared as for a radical mastectomy. The arm of the affected side is held on an arm board at 90 degrees' abduction. Under pentothal gas anesthesia the incision to secure biopsy material is made. The tumor, with a good sized margin of normal tissue and overlying skin is excised without squeezing, manipulating, clamping or spilling it. The gross section is examined with the pathologist present. A typical cut section of the gross specimen of scirrhous carcinoma, and such growths comprised the type of tumor found in most of our cases, showed a grayish, irregular, firm, gritty mass which was firmly adherent to the surrounding tissue and which sent fibrous streaks shooting into the fatty tissue. The section may be homogenous or it may show the pale yellow dots and streaks of necrotic cells. The cut surface is usually concave. Small cysts are infrequently seen.

Frozen section or Terry stains of the specimens are made immediately. If the microscopic diagnosis reveals a benign lesion, surgery consists of excision of the tumor. If the pathologist reports a malignant growth, surgery consists of radical mastectomy.

The technique of radical mastectomy has been fairly well standardized since the turn of the century. Individual surgeons have employed variations of technique and thoroughness in removal of tissue. In our clinic the operation consists of the amputation of the breast, together with the removal of the pectoralis muscles and a clean dissection of the axillary and subclavicular region. The entire mass is removed *en bloc* to safeguard against transplantation of malignant cells; such transplantation may occur by traumatic or mechanical dissemination of cells within the operative field. Intravenous fluids are not employed during operation or subsequently, as a rule. In no case was severe shock seen at the time of the operation or later.

The type of incision utilized and the amount of breast tissue removed depend on the location of the tumor in the breast, type of breast, size of the breast, and the bodily build of the patient. A wide skin incision is essential if local skin recurrences are to be avoided. Wide superficial and deep fascial removal is likewise important. Many recurrences come from this fascia. All skin around the breast and as much as possible about the tumor are removed. In some cases wide skin grafting has been necessary.

It has been wisely said that one surgeon should be charged with the most radical removal of the tumor and another should be responsible for the closure of the wound; thus the thoughts of closure would not hamper the operating surgeon in the radical excision of tissue. Generally, we have employed a transverse elliptical incision encircling the breast and extending from the posterior axillary line about 10 centimeters below the axilla to the lower midsternum. A second incision at right angles to the transverse incision is carried upward to the shoulder about 3 centimeters medial to the anterior axillary line. This incision provides good mobility of the arm with very little limitation. With this type of incision we have had no axillary cicatricial contractions. Painful contracting scars can be produced by irradiation as well as by improperly placed incisions. Edema of the arm as an aftermath has seldom occurred. Transient and intermittent slight edema of the arm due

to lymph blockage has occurred and this is expected. Thorough cleaning of the axilla will produce some lymph edema. Venous obstruction which may result from pressure on the axillary vein by scar formation has not occurred. The incision permits the maximum removal of skin about the breast. It provides desirable exposure of the axilla which aids in thorough axillary cleaning, removal of the pectoralis muscles, and cleaning of the chest wall. It aids in getting good closure and prevents cicatricial tissue formation in the anterior fold of the axilla. Elliptical incisions along the anterior axillary fold as well as other types of incisions have been used but only in cases in which the transverse incision has not been applicable. The skin incision is made into the subcutaneous tissue, and the flaps are dissected free by undercutting close to the skin to prevent local recurrences and deposits of cancerous cells in the superficial lymphatics.

Hemostasis has been secured by means of plain catgut ligatures or by electrocoagulation of bleeding points. The latter method reduces the operative time. About the same amount of serous fluid has been collected in the wound by either method.

The pectoralis major is severed at its attachment on the humerus and then is separated from the clavicle and retracted downward and medially. The coracoclavicular fascia is incised and the pectoralis minor muscle is severed at its insertion on the coracoid process. This muscle and the pectoralis major are then retracted downward, thus exposing the axilla. The dissection of the axilla is begun at its apex, progressing from above downward removing fatty tissue, lymph glands, vessels, and areolar tissue in the process. Axillary cleaning is important because lymphatic permeation is the all important method of spreading the disease not only locally but also at a distance. This procedure permits the removal of all of the structures including the breast, the pectoralis major and pectoralis minor muscles, pectoral fascia and axillary contents in one mass. The chest wall is cleaned thereby diminishing the liability of malignant cells spreading into the adjacent tissues. Throughout the surgical procedure hot moist tapes are used over all exposed

tissue. This step prevents rapid cooling of the body, aids in hemostasis, prevents overmanipulation of tissue, aids in exposure and in the prevention of shock.

Primary closure with interrupted steel alloy sutures has been used in recent years. Prior to that time interrupted cotton sutures were used. The wound has been closed tightly without drainage. Tension sufficient to produce necrosis beneath the sutures is seldom employed. If skin grafts are needed a thick split skin graft is taken from the anterior thigh. A small incision in the axilla, closed with a single suture, will serve as a drainage area. On the third postoperative day this incision is opened to permit drainage of accumulated serum and blood. Closure in the manner described permits the patient to be ambulatory early, the wound to be kept closed, air to be kept out, the dressing clean, less frequent changes of dressings, control of drainage, and finally the patients like it.

After operation the arm of the affected side is suspended upright by traction on the forearm, the upper arm being kept in 90 degree abduction and the forearm at right angles to the upper arm. Gradual motion and exercise is encouraged from the outset. In 3 or 4 days the traction is removed, and the patient has little or no limitation of motion of the extremity and no postoperative swelling. The patient is out of bed on the fourth day or fifth postoperative day. Within 7 to 10 days the wound is healed, sutures have been removed, drainage has stopped, and the patient is ready for postoperative irradiation.

#### PATHOLOGY

TABLE V.—PATHOLOGICAL DIAGNOSIS IN 205 CASES OF CARCINOMA OF THE BREAST AS REPORTED BY PATHOLOGISTS

Carcinoma reported	Number
Scirrhous carcinoma.....	111
Infiltrating duct carcinoma.....	31
Adenocarcinoma.....	21
Simplex carcinoma.....	16
Medullary carcinoma.....	9
Papillary cystadenocarcinoma.....	4
Comedo cancer.....	4
Colloid carcinoma.....	3
Solid type carcinoma.....	2
Paget's cancer.....	2
Acute inflammatory carcinoma.....	2

Table V presents a list of the types of breast cancer by name and in the order of frequency as reported by pathologists in the hospitals of this city. It is not a classification. It is realized that two or more of these diagnoses may occur in the same breast. One section may show a scirrhous carcinoma while another may show a duct cell type carcinoma. The microscopic diagnoses were from plugs of tissue made into paraffin sections. There were no whole organ diagnoses.

Some pathologists reported the grade of malignancy and others did not. Consequently, there has been no tabulation of this information. The table shows an overwhelming number of scirrhous carcinomas. This type of growth is the slow growing and radioresistant cancer. The 31 cases of infiltrating duct cancer may be considered in the same category as the scirrhous carcinoma. There were 21 cases of adenocarcinoma. These growths are of relatively low malignancy and remain localized for a long time. Axillary node involvement is exceptional. Grossly the adenocarcinoma is a bulky, soft tumor. There were 9 cases of medullary cancer, which is a rapidly growing tumor and often invades the skin, ulcerates, and appears on the surface as a large, fungating mass. We had 2 cases of acute inflammatory cancer.

One was that of a well developed, well nourished woman of 35 years who had two children. One child was 4 years of age and the other a newborn. In the terminal weeks of her second pregnancy she developed a slight hardness and enlargement of the left breast. After delivery the swelling and hardness persisted. The breast became tender and painful. The pain was generalized and grew progressively more severe. We first saw her 6 weeks after the onset of symptoms and at this time the left breast was enlarged, hard, reddish, and very tender. It was opaque to transilluminated light. There was a hard, round, freely movable gland about 1 centimeter in diameter in the left axilla. The roentgenogram of the chest was negative. She did not nurse the newborn baby. A left radical mastectomy was done with extensive removal of skin tissue and extensive cleaning of axillary and clavicular regions. A large skin graft was taken from the thigh to cover the left breast area. The pathological diagnosis revealed infiltrating duct carcinoma, grade III, with metastasis to regional lymph nodes. Postoperatively, she was given roentgen therapy to the left breast, axillary, and clavicular regions. She was sterilized by the roentgen therapy and supported with testosterone propionate. Six

months after surgery she appeared to be in fair condition. She has maintained her weight and there is no evidence of metastasis but she has had a difficult time with the pain and the discomfort of roentgen therapy. Prognosis is poor in her case. The increased vascularity and cellularity of the mammary gland, the intensified endocrine influence, the rapidity of growth, the diffuseness of the growth, the glandular involvement, the grade of malignancy give us cause for pessimism in the prognosis of this case.

#### ROENTGEN THERAPY

We have employed postoperative irradiation and irradiation for recurrences or metastatic carcinoma as a routine. In some cases in which the disease was well within the limits of surgical dissection postoperative roentgen therapy was not given. In selective cases we have employed irradiation castration. This phase of therapy is probably most beneficial in cases with metastatic involvement. Irradiation extends the margin of safety and prevents or inhibits recurrences from malignant cells which may have been spilled in the wound or were present in places inaccessible to surgery. The results obtained with roentgen therapy will depend upon the pathological histology, the radiosensitivity of the tumor, the extent of involvement, the bodily build of the patient, clinical course of the disease and other factors. In general, the technique of divided dosage has been used especially when the disease has spread beyond the limits of the involved mammary gland itself. Thus the margin of safety is extended to the parasternal axillary, and clavicular regions.

Irradiation has been initiated within 2 weeks after operation. It has not interfered with healing and has not delayed convalescence. Scirrhous carcinoma is highly radioresistant as are most tumors that are markedly desmoplastic. The highly cellular medullary form may be quite sensitive to irradiation. Adenocarcinoma and duct carcinoma do not respond well. The rapidly growing anaplastic forms respond best, but as they metastasize at an early date they have the worst prognosis. The large amount of fat in the breast is a formidable barrier to irradiation. The outlying islands of tumor cells are very apt to escape unharmed. Microscopic sections of tissue removed at the time of surgery show that the lymph nodes on the anterior surface of the

pectoral muscles are involved in many cases of scirrhus carcinoma at the time of operation. Such nodes are hard to reach with irradiation alone.

Irradiation castration in premenopausal women was employed in selected cases. Irradiation of ovaries has been used to eliminate the ovarian estrogenic function, prevent pregnancy, and the physiological process accompanying pregnancy. This has not been a routine practice because it is felt that the benefits are temporary. Menses often reappear and the ovarian function re-establishes itself. The ordeal is most uncomfortable and it produces many complaints from patients and not a little emotional and nervous upset. Many patients have stated that they would prefer another operation rather than submit to further irradiation. Notwithstanding these apparent disadvantages we have continued with irradiation castration and have not employed surgical castration. In some instances the patients have been supported with testosterone propionate. Massive dosage of 100 milligrams or more daily are required to inhibit estrogen function and give palliative relief. At the present time the cost of this drug in the required dosage is prohibitive to most patients.

#### FINAL RESULTS

There were no operative deaths and no cases of shock. This fortunate circumstance was favorably influenced by the maintenance of good standards in determining the operability of patients as outlined, by proper pre-operative preparation, by competently administered, suitable anesthesia, by hemostasis, the use of hot tapes during the operative procedure, by the avoidance of shock and by the employment of atraumatic surgery as much as possible. No fluid was administered intravenously during the surgical procedure. In 30 patients operated upon within 3 years there was no metastatic involvement. Two, or 7 per cent, of these died of recurrences of the disease. Thus 93 per cent of those operated upon within the past 3 years are living and well. Of the 60 without metastatic involvement who have been operated upon more than 3 years ago, 49 are living and well. For those without metastatic involvement and who were

TABLE VI.—FINAL RESULTS IN 205 CASES OF CARCINOMA OF THE BREAST

	Without metastasis	With metastasis
Operative deaths.....	0	0
Living and well but operated on less than 3 years ago....	28	31
Total deaths from recurrence of those operated upon less than 3 years ago ..	2	7
Living and well more than 3 years ..	14	11
Living and well more than 4 years ..	9	9
Living and well more than 5 years ..	27	19
Deaths from intercurrent diseases ..	3	4
Total deaths from recurrence of the disease more than 3 years after surgery ..	10	31
Percentage survival of those operated upon less than 3 years ago ..	93.3	81.6
Percentage survival of those operated upon more than 3 years ago ..	83.3	55.7
Percentage survival of those operated upon more than 5 years ago ..	80.1	51.4

operated upon more than 3 years ago the percentage survival rate is 83.3. If operated upon more than 5 years ago the percentage rate is 80.1.

With metastatic involvement the results are less favorable. There were 38 patients with carcinoma of the breast with metastatic glandular involvement who were operated upon within the past 3 years. Seven, or 18.4 per cent, of these have died of recurrences. There were 74 patients with metastatic glandular involvement who were operated upon more than 3 years ago. Thirty-nine of these are still living and well. Of those with metastatic involvement who were operated upon more than 5 years ago 51.4 per cent are living and well. Table VI shows that the results are much better when patients are operated upon before glandular invasion has occurred.

#### RECURRENCE AND METASTASIS

Sooner or later after carcinoma of the breast has been treated the disease may again manifest itself. Treatment as we have mentioned will retard and delay recurrences and metastases. In 1 case of carcinoma of the breast treated with radical mastectomy the metastasis became clinically evident 12 years later.

One wonders if this was a recurrence, a metastasis, or a new-growth independent of what has gone on before. When metastasis occurs it becomes the duty of the physician to use means at hand to combat the growth, prolong life, give comfort and encourage a cheerful outlook.

Bone, visceral, and skin metastases may occur from any grade of breast cancer. The metastasis is a manifestation of the generalized extension of the disease throughout the body. The extension may have taken place by lymphatic extension, by permeation, by lymphatic emboli, by embolic dissemination and by way of the blood stream. The most frequent osseous structures involved are the vertebrae and pelvic bones and the most frequent visceral involvement are the lungs and abdominal organs. Pain usually is the first clinical warning of the presence of cancerous tissue in bones. The pain is caused by involvement of the periosteum or adjacent nerve trunks with metastasis or surrounding inflammatory reaction. Visceral metastasis to the pulmonary, pleural, and mediastinal structures will manifest itself with pleural effusion, cough and pain, dyspnea and orthopnea. When abdominal organs are involved there usually is an abdominal mass with ascites. In the skin we find carcinomatous dermatitis with skin nodules of various sizes, some of which may ulcerate. Roentgenograms are taken if complaints of pain and other evidence suggest the possibility of metastasis. Irradiation can be applied to structures involved by cancer which are inaccessible to surgery. Palliative measure may include tapping of fluid in serous cavities, irradiation, hormonal therapy, excision of skin nodules, relief from pain, sedation and psychosomatic therapy.

#### SUMMARY

Routine and frequent examination of the female breast is the key to discovery of much early mammary carcinoma. All breast tumors with the exception of the simple cyst which totally disappears on aspiration should be re-

moved surgically and a pathological diagnosis made.

A lump in the breast was the most frequent indication of carcinoma in our series; 88.3 per cent had this complaint. Over 50 per cent of the patients knowingly possessed a lump in the breast more than 6 months before submitting to treatment. The fourth decade was the most vulnerable to carcinoma of the breast, both as to frequency and metastatic glandular involvement. In 54.6 per cent of the cases the regional lymph glands were involved with metastases. Surgical biopsy and microscopic diagnostic examination were carried out preoperatively in all cases. Routine treatment consisted of radical mastectomy and postoperative irradiation. The surgical technique permitted maximum removal of tissue *en bloc*. Removal was done through a transverse elliptical incision which encircled maximum skin tissue and breast tissue about the tumor. A second incision is made at right angle from the first upward to the shoulder. The pectoralis major and minor muscles were removed, and thorough cleaning of the axilla, clavicular regions and chest wall was done as part of the surgical procedure.

Postoperative irradiation was carried out as a routine. In selected cases preoperative irradiation and irradiation castration have been employed.

The final results show that those operated upon prior to metastatic involvement live longer and the prognosis is much better. In cases without metastasis there was a 93.3 per cent survival rate for those operated upon within 3 years and an 80.1 per cent survival rate for those operated upon more than 5 years ago. Whereas in cases with metastatic involvement the survival rate for those operated upon within 3 years was 81.6 per cent and for those operated upon more than 5 years ago the percentage survival was 51.4 per cent.

Metastases to bone and viscera take place equally well. Once metastasis has occurred the outlook is usually poor and it becomes necessary to use palliative means to keep the patient comfortable and cheerful.

# RECONSTRUCTION OF BONY DEFECTS OF THE FACE

## With Special Reference to Cancellous Iliac Bone

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**D**EFINITIVE phases of war surgery have indicated functional and cosmetic restoration of damaged and destroyed bone. A conspicuous portion of such surgery is concerned with facial and cranial structures. Vast numbers of cases, many with aberrations and complications rare or unknown in civil practice, have afforded an unprecedented opportunity to appraise several methods of treatment. In one of the Army's plastic and maxillofacial surgery centers during the past year we have performed approximately 200 operations requiring replacement of bone and restoration of contour in the face and jaws. Adequate data are now at hand for a fair comparison of substances and tissues used and techniques applied. The purpose of this paper is to review our experience with tantalum, acrylic, homogeneous and autogenous cartilage, and bone. Evidence indicates that cancellous iliac bone is the substance of choice in the repair of the majority of such defects, large and small. The chief exceptions are large soft or pulsating cranial defects, which are being so successfully covered by tantalum plates. However, numerous depressed skull fractures and contour defects common about the frontal processes, orbital rims, malar and zygomatic regions are effectively corrected with relatively simple cancellous bone grafts. Results have been uniformly good, even in areas badly crushed, septic until recently, or complicated by foreign bodies.

### TANTALUM

Success of neurosurgeons in applying accurately prefabricated metal plates to cranial defects led a predecessor to attempt their use in camouflaging depressions incidental to irreducible malar fractures. Immediate cosmetic effects were fair in several cases, but

septic reactions and displacements demanded their early or ultimate removal in all but 3 cases. To our knowledge, about 1 out of 2 patients was dismissed with the plate in place; in the other cases the operation was redone with bone or cartilage. Not insignificant were patients' complaints of sensations of cold upon exposure during cold weather. Thus, this method of dealing with facial contour defects was abandoned.

### ACRYLIC

Observations upon acrylic implants are very limited. The eye department is pleased with results from wedges of the substance in damaged or depressed orbital floors to elevate the globe of the eye. There is a possibility of these bodies eroding into the antrum in case of tissue reaction where bone is missing and much fibrous tissue present. No such instances have occurred, however, and the patients are improved cosmetically and functionally. For the sake of discussion, however, the plastic surgery department contends that all of us would feel more confident in utilization of a viable substance, such as cancellous bone, in precarious locations.

One officer patient presented himself with the lower end of an acrylic implant protruding from his left nostril. It had been inserted overseas to correct a traumatic saddle nose. There was no evidence of sepsis, but the nasal mucosa apparently had undergone a pressure necrosis and given way. Certainly this would not have occurred over viable autogenous tissue.

It may be safe to predict that indication for this means of tissue support will be limited to very few cases.

### FASCIA LATA, FAT, AND DE-EPITHELIALIZED SKIN

For small depressions—where protection of underlying structures, rigid support, or strength

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Fig. 1, left. Irreducible depressed malar fracture with bone loss

Fig. 2. Correction of contour and restoration of orbital rim with cancellous bone. Graft was not wired in place; it was inserted into a pocket against freshened bone of recipient site.

are unimportant—fascia lata serves admirably. One or two strips taken with the fascia stripper may be tucked into the depression through a tiny incision, distributed and modified as requirements indicate. It is found that overcorrection is not necessary, since shrinkage or absorption is negligible.

Apparently fat has been practically abandoned as a free graft. It seems not to be readily vascularized, has low resistance to infection, is prone to absorption and fibrosis. Thus danger of unpleasant immediate complications is great; central portions of large grafts are subject to liquefaction and necrosis; the degree of absorption is unpredictable. Certainly there has been no indication, to our knowledge, for the use of free fat in war surgery.

However, fat as a small attached local rotation or sliding subcutaneous flap has served us well for correction of innumerable small depressions. Penetrating, perforating, and lacerating wounds of the face, with varying amounts of tissue lost, have resulted in every manner of superficial defect. Grooves, furrows, pits and depressions catch lights and shadows in such a way as to accentuate their importance, especially to sensitive patients. In depressions involving the beard area, the chief complaint is returned hairs and interference with shaving.

Practically anywhere on the face it is possible to draw a pedicle of adjacent attached fat into a small depression without noticeably or objectionably altering contour of the area.

It may be preferable to use figure-8 or other removable stitches to hold the pedicle in place until it is established, rather than to chance irritation or foreign body reaction to buried suture material.

Previous literature has recommended and evinced a moderate amount of enthusiasm for skin minus its epithelium for filling shallow depressions or for strengthening so-called weak integument. It is my impression that it cannot do anything that fascia lata or other tissue cannot do better and with less danger of sepsis and absorption. One cannot be certain that all secreting and excreting elements of the skin have been removed. Tissues that have survived the inestimable crushing and concussion of a war injury may be less able to cope with factors which complicate or retard healing than are tissues that have endured less violent trauma. We have had no occasion to use this technique in any of the depressed areas and have dismissed it as impractical, at least in a series of this type.

#### CARTILAGE

Obviously cartilage is established as a tissue of choice in many defects, particularly nasal depressions and ear reconstructions. The only debatable phase of the question seems to be whether the cartilage shall be homogenous or autogenous. Advocates of the former contend that it is preferable wherever cartilage is indi-



Fig. 3, left. Large bony loss beneath superficial defect now occupied by pedicled flap graft.

Fig. 4. Lower orbital rim, malar bone, and zygomatic arch have been replaced by one large block and several smaller fragments of cancellous bone.

cated, chiefly because it saves the patient an uncomfortable incision over the costochondral region and because it is less apt to twist or curl. Other considerations being at least equal, we have preferred preserved cartilage because of its saving us the additional surgery to procure autogenous substance. It may be stated conservatively that utilization of the preserved tissue saved us at least 70 operations during 1945. Considering the fact that 3500 operations were carried out in the plastic surgery department of a single hospital during this period, we grant that such a time saving consideration enables us to perform an increased total number of operations. We have buried many plates of preserved cartilage beneath the skin about burned and partially destroyed ears and placed split skin grafts behind them a few weeks later with practically no disappointments. Even in instances in which scar epithelium looked as though it might break down if undercut, the skin has survived and improved as it has contributed to the reconstruction of an ear. These ears appear to be substantial and so far as we know the cartilage is showing no tendency to be absorbed. I recall 2 instances of cellulitis which subsided without loss of the cartilage and 2 instances of gross infection, mentioned later, in which it was expelled or removed. It will be interesting to note whether any of these patients suffer absorption or expulsion of the graft in the future. After all, preserved cartilage is nothing more than a benign foreign body. A previous generation of surgeons favored ivory—and some of it did its work quite well for years. In 1943 in the European theater I removed an ivory implant, from one of the older Air Corps officers, that had been placed in his traumatic saddle nose following an airplane crash in World War I. It had become displaced and had festered periodically during the past 3 years. Dorsal and columellar elements were ingeniously dovetailed together like an intricate Chinese puzzle. There was no evidence that time had in any way impaired the material. After a few weeks this nose was successfully built up with a cancellous iliac bone graft.

Since the type of work done in this military hospital is rarely followed by a death, we have



Fig. 5, left. Depressed fracture of frontal bone.

Fig. 6. Result from insertion of one large and several smaller pieces of cancellous bone. Note incision above hairline.

had no opportunity to collect any cartilage from the department of clinical pathology. Thus we came to depend upon other institutions to procure for us the material from suitable donors under aseptic precautions. We cultured the material, transferred it to new merthiolate-saline solution and refrigerated it. Repeated cultures were made on any specimens kept over 2 weeks; they were discarded if other than "no growth." Despite these precautions we had 4 cases of infection from one batch of cartilage in the only 4 patients in whom it was used. Drainage from each of 2 ear grafts and 2 nose grafts gave a culture of hemolytic *Staphylococcus albus*. The ear grafts were lost but the nose grafts retained, with some absorption in one and no tangible change in the other. We have not used any preserved cartilage since this experience, and probably will not unless a more dependable source becomes available to us. For small ear cartilage grafts, we take some from the opposite concha in unilateral cases. In instances requiring larger grafts we are making the costochondral incision. For supporting substance elsewhere than the ear, we prefer cancellous bone in most cases. Thus the number of rib cartilage incisions is not a burden to us or to the patients at this time.

#### CANCELLOUS BONE

Various comments in the above sections indicate the chief message conveyed in this paper—our unqualified satisfaction with cancellous iliac bone. During 1945, 117 iliac bone





Fig. 7. X-ray appearance of large malar compound replacement after 6 weeks.



Fig. 8. X-ray appearance of mandible graft, clinically firm at 7 weeks.

grafts have been used in facial and jaw defects operated upon by the plastic and maxillofacial department in this one Army specialty center. They have been used in defects which have undergone every possible complication which would make them poor risk areas. Many were the result of severe lacerations or crushing injuries; others communicated with septic sinuses and oral cavities; some housed foreign bodies and sequestra; in several previous attempts had been made at repair with nonvital substances such as vitallium, acrylic, or preserved cartilage; a few were defects which had been abscessed or involved in an area of osteomyelitis or cellulitis. Former arbitrary waiting periods of, say, 5 months between septic or potentially septic conditions

and performance of bone grafts have been ignored. We have merely waited, as a rule, from 3 to 5 weeks after cessation of drainage or subsidence of other signs of sepsis. Penicillin, 25,000 to 50,000 units every 3 hours, has been given routinely for several days post-operatively in all cases except those considered in no way potentially septic. It is granted that this fortification against possible septic complications has encouraged our boldness in proceeding early.

There have been no regrets and no graft has been lost. In 1 instance a small piece of thin cortical bone, which had been left on the graft, separated and had to be removed as a sequestrum. Several patients had local swelling and serosanguineous fluid was aspirated one or



Fig. 9. Low power photomicrograph of hoarded cancellous bone after 8 weeks. No cortex had been included upon the original specimen.

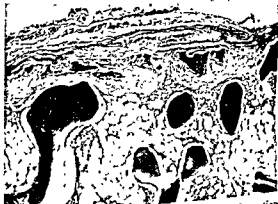


Fig. 10. High power photomicrograph. In this section is shown the new bone and cortex formation at the periphery.

more times from about the bone. Two patients have had cellulitis in overlying skin; with continued penicillin systemically and wet packs locally, it has soon subsided. In no case has the bone graft appeared to be threatened. Union and consolidation occur early and clinical firmness usually is present during and after the third week.

Certain technical considerations which conserve time at the operating table and contribute to uncomplicated healing are worthy of notation: General anesthesia is desirable, if not mandatory, pentothal being used in operations which can be done in approximately an hour and intratracheal gas-oxygen-ether for the longer ones. However, consumption of the anesthetic agent is minimized and gratifying hemostasis attained by injecting both donor and recipient sites with 1 per cent novocain containing 7 to 10 minims of 1:1000 adrenalin per ounce. An incision about 4 inches long parallel to, and just below, the right iliac crest is made to the bone. A wide sharp chisel quickly unroofs the ilium and turns its outer table down like a trap door. The desired amount of bone is removed consisting, if a large amount is taken, of one large block and a few small ones. If the graft is to be large and will require rigidity or strength, as for a jaw, it is well to leave all or part of a thin layer of cortex on one side. Otherwise it may break during its shaping and fixation or early in the convalescence before new bone formation solidifies its structure. An assistant proceeds with closure of the donor area in layers, leaving a Penrose drain for 24 hours. Soft voluminous pressure dressings held in place with wide circumferential stockinette bandages permit a tolerably comfortable postoperative period. Patients state that the "hip was uncomfortable for 7 or 8 days"; most become ambulatory voluntarily at the end of that time. At the recipient site it is commonly possible to excise or reopen an old scar line; otherwise an incision is made favorably situated in the direction of Langer's lines. A pocket is made for the graft, and the bone is freshened at one or more places for contact. Tantalum wire is used for fixation of some of the larger grafts, chiefly those of the mandible and the larger ones in the malar region. In the majority of

other depressions—as orbital rim, forehead, or nose—the recipient pocket contains the bone firmly and no special fixation is indicated. After the main block is in place, dead space and contour irregularities are occupied by chips of the residual cancellous material. It is readily broken or cut with stout knife or scissors, then laid or pressed into place until contour and bulk are correct. Simple closure without drainage and soft pressure dressings maintain the bone safely "home." Usually firmness is noticed at the first change of dressings from 3 to 5 days later. At that time, penicillin is withdrawn if there is no evidence of a septic reaction.

There can be no doubt that cancellous bone is rapidly vascularized, probably as rapidly as a free skin graft. Otherwise it would not "take" so dependably in areas badly traumatized and formerly or potentially septic. It is actively osteogenic and rapid new bone formation is grossly indicated by the early firm attachment and substantial feel.

A left-over block of the material was hoarded in a patient's subcutaneous abdominal fat. It was removed for study at the end of 7 weeks. Our pathologist (Major G. D. Ayer, Jr.) described the gross specimen and his comment, in part, upon the microscopic picture is as follows: "Nine sections comprise gross serial cross sections taken in the long axis of the specimen. In most locations there is incomplete formation of cortex beneath the moderately dense connective tissue investment."

On a previous occasion, in the case of the Air Corps officer whose ivory graft for saddle nose was replaced by a cancellous iliac bone graft, a spindle-shaped piece of the material was likewise hoarded. Several months later an x-ray flat plate of the abdominal wall showed the specimen with a dense cortex and less dense medullary core.

#### SUMMARY

The problem of restoring facial bones functionally and of correcting contour defects cosmetically has been surveyed in a general way. No attempt has been made to describe any one method in exhaustive detail. However, the use of various materials, both inorganic

and organic, homogenous and autogenous, has been discussed entirely from personal observation and experience in an unusually large series of cases. Results from foreign substances have been consistently bad; utilization of homogenous human substance brings in added possibilities of contamination, incompatibility and tissue reaction; autogenous tissue, other than bone, in some cases has been inadequate, undependable, or unpredictable. Cancellous bone has served well, often in areas that had been badly traumatized or septic, with success and gratifying end-results.

Several exemplary cases are mentioned, some with "before and after" pictures illustrating corrections which show no tendency to become distorted, absorbed, or otherwise modified by time. Since the graft is composed of living and established tissue, there is little or no danger of ultimate disappointment.

Gross observation and microscopic study has been made upon hoarded specimens to demonstrate that these grafts become rapidly vascularized, are osteogenic, and develop their own cortex. Their survival does not depend upon bony contact.

#### CONCLUSIONS

1. For correction of contour defects and bony losses in facial structures, several substances are available. It is my opinion that all of the foreign substances should be abandoned.

2. Homogenous preserved cartilage has its useful place, particularly in replacing lost ear cartilage and in other relatively minor defects where strength or support is not a significant requirement. It should be taken from a proved "clean" donor under aseptic conditions, preserved in antiseptic solution changed occasionally, refrigerated, and cultured every 2 or 3 weeks.

3. Fat is practically useless except as a local attached subcutaneous pedicle for small depressions.

4. Fascia lata is sometimes preferable for shallow depressions and probably serves more safely and dependably than de-epithelialized skin.

5. Iliac cancellous bone is a singularly dependable, utilitarian, safe, and satisfactory tissue for correction of the types of defects that have been discussed.



gauze to prevent aspiration of material into the lower air passages. In cases of this kind because of the usually marked extent of disease it is our belief that a radical neck dissection should accompany the resection of the mandible whenever the general condition of the patient will allow, and this will apply to most patients under 60 years of age.

On these occasions the dissection is begun just above the clavicle with division of the sternomastoid muscle and the internal jugular vein. When the level of the external carotid artery is reached, this vessel is ligated in continuity distal to its superior thyroid and laryngeal branch. Pads are placed in the lower part of the wound, and attention is momentarily diverted to the oral cavity. Here the mucosa of the floor of the mouth is incised as far as the subjacent lesion requires, either the scalpel or the endotherm knife being used. On introducing a finger into this incision one finds a ready plane of cleavage between the mylohyoid muscle and the muscles of the tongue. The lingual nerve is appreciated as a band and some care must be exercised to prevent its avulsion. A similar incision is made through the mucosa of the gingivobuccal gutter, and by blunt finger dissection this is easily deepened into the subcutaneous fat of the cheek as far as is indicated, usually to the inferior border of the mandible. Very little bleeding results if the facial veins are not torn. These two incisions are lightly packed with moist gauze. The upper cervical skin flap is next developed superficial to the platysma muscle whereupon communication is established with the lateral mouth plane. All skin attached to the mass is widely sacrificed. At the spot chosen for sectioning the mandible, a Gigli saw is passed around it and the bone is severed. The contents of both submental spaces are dissected to the lateral border of the ipsilateral anterior digastric muscle belly; the portion of mandible to be removed is retracted upward and laterally, and the mylohyoid muscle is cut free of the hyoid bone. Thus the node mass is left entirely undisturbed, bounded superiorly by the mandible, externally by the platysma muscle, and deeply by the mylohyoid muscle. From this point one may proceed to free the man-

dible from its muscular and ligamentous attachments and to complete the upper posterior portion of the neck dissection in the usual manner. The mucosal edges of the oral cavity wound are apposed by means of a Connell type of stitch reinforced with a row of interrupted sutures. After mucosal closure has been completed the entire neck wound is lavaged with liberal amounts of physiologic saline. Several small Penrose drains are appropriately placed and the wound is closed.

Whenever considerations relative to the patient's physiologic reserve indicate that so extensive a procedure may not be tolerated, attention is paid to the known disease first. The external carotid artery is ligated, the intraoral incisions are developed, the upper skin flap is formed, and coincident removal of the jaw and submaxillary contents is continued. Before the specimen is detached laterally, however, an appraisal of the situation may again be made with completion of the neck dissection from above downward if circumstances latterly seem to warrant it. Though one is naturally desirous of doing wide *en bloc*, dissection of all suspected tissues, the initial accomplishment of a suprahyoid dissection and mandible resection followed at a later date by completion of the neck dissection is entirely feasible and is certainly an occasionally legitimate compromise in poor risk patients. Whenever extensive disease is also present in the primary tumor site, this is widely excised (lip, buccal mucosa or gingiva) in continuity with the jaw and node. It will sometimes be impossible to accomplish an immediate restoration of the part. Resultant defects are left for subsequent repair and anticipation of them should in no way influence the primary consideration, namely wide removal of the tumor mass.

In sectioning the mandible the functional and cosmetic results are directly proportional to the amount of chin which can be spared. When the anterior portion of the mandible must be sacrificed because of tumor fixation bilaterally, the typical "Andy Gump" deformity results. When bilateral submaxillary metastases are present which though firmly attached to the mandible on one side are only moderately fixed over a small area on the

other, it has been our practice to resect the mandible with the nodes on the side of the marked adherence only. On the opposite side several millimeters thickness of the inferior border of the mandible only is removed, the object being to spare the anterior mandible whenever this can be accomplished without undue risk. Detachment of the anterior tongue supports (genioglossus muscles) permits that structure to be drawn posteriorly and downward filling the hypopharynx interfering with the airway, sometimes for a prolonged period. Speech and proper deglutition are permanently impaired. Drooling is very apt to occur. In accomplishing lateral mandibular resections it is therefore important to preserve as much of the anterior jaw as possible. It has been our practice to remove less mandible in the absence of roentgenographic evidence of involvement than when such involvement was demonstrated to be present. Usually the bone is cut 0.5 to 1.0 centimeter anterior to the attachment of the mass when roentgenologic signs of bone destruction are absent. Since the involvement is usually along the inferior border of the mandible we have practiced cutting the mandible obliquely so as to preserve a 1.5 by 2.5 centimeters longer superior than inferior border. If the bone is invaded, however, one has little knowledge of how far extension in the medullary canal may continue, and if the bone involvement is extensive, it seems likely that the safest point for anterior division of the jaw would be through the symphysis. After the mandible is freed of its muscular attachments, it is then customary to disarticulate it. In order to avoid troublesome pericapsular bleeding about the joint the condyloid process may be severed with a rib cutter, however. In the absence of advanced bone invasion this should result in no harm. On the contrary a large fragment of ascending ramus left behind will not only increase the chances of recurrence but will invariably be drawn upward and inward by uncompensated temporal and pterygoid muscle pull and will produce severe discomfort on mastication.

Catgut of suitable size is used throughout except for skin closure which is accomplished with silk or cotton. Buried nonabsorbable

suture material, though it does no harm has produced late granulomas which are extremely worrisome to the patient who is usually alert for signs of recurrence.

The actual cautery has not been used in any of the procedures since the need for sealing lymphatics is highly theoretical. Should the lymphatics at the point of transection be permeated by disease, it is highly unlikely that the cautery would be any more effective than the scalpel in preventing recurrence. The cautery presents the disadvantages of so altering the tissues as to interfere with accurate palpation which we consider to be essential to accurate removal, and also interferes with primary healing. Careful local hemostasis aided by preliminary arterial ligation for the rigid maintenance of exposure and careful palpation with wide excision are essential, we believe, if one is to safeguard against transecting cancerous tissue.

Where trismus is present preoperatively, tracheotomy is done preliminarily and the anesthetic is administered by this route. Excepting such instances, however, the tracheotomy is not done until the resection has been completed and it is then accomplished routinely. The patient is informed before the operation that he will be unable to speak for several days following it and that the tracheal opening will be permitted to close spontaneously when all swelling in his throat has subsided. Tracheotomy tubes require considerable nursing care in keeping them clean and free of mucus. Increasing the humidity of the room by means of a steam kettle will diminish tracheobronchial secretion and crusting of mucus. At least one transfusion, and usually several are administered during the operation. These are given to replace blood lost and as prophylaxis against shock. Accordingly transfusion is begun shortly before or at about the time the skin incision is made. Hot saline mouth irrigations are started on the day after operation to cleanse the intraoral suture line and are repeated at hourly intervals during the day until the mouth is well healed. If the patient evidences no nausea, a small caliber Levine tube is passed into the stomach on the first postoperative day, and tube feedings are begun in small amounts of 100 to 150 cubic

centimeters five or six times daily, increasing the amount each day to meet bodily requirements. At the first complaint of nausea the gastric contents are aspirated, the tube is removed, and the feedings are temporarily discontinued. A patient with a tracheotomy tube is unable to clear his airway with the explosiveness that the functioning glottis permits and therefore all possibility of aspirating food must be strictly avoided. The patient is urged to get out of bed by the third or fourth postoperative day. Prior to that time he generally feels too ill to do so.

CASE 1. No. 4109. Patient a white male, aged 61 years, was admitted May 15, 1942. An unidentified tumor was removed from the mucosa of the right cheek with cautery 8 months before admission. He had had a lesion of the left lower lip treated similarly 7 years previously. For 3 months prior to hospital entry he had noted progressive enlargement of a mass in the right submaxillary space recently productive of constant pain in the jaw.

Examination revealed an old scar on the left vermilion border of the lower lip and another on the right buccal mucosa just posterior to the commissure of the mouth. The entire right submaxillary space was filled with a large mass approximately spherical and solidly fixed to the mandible. The overlying skin was thin, tense, and discolored indicating impending breakdown. There were no other palpably enlarged lymph nodes. An aspiration biopsy specimen was reported epidermoid carcinoma. Roentgenograms of the mandible showed no evidence of bone invasion and those of the chest gave no evidence of metastatic carcinoma.

Accordingly on May 29, 1942, an *en bloc* resection of the right mandible and contents of the right neck (excepting the posterior triangle), was done and the postoperative course was uneventful. The laboratory examination of the specimen revealed involvement of the large submaxillary node only with extension out into the surrounding soft tissues. There was bone invasion in one area and wide periosteal involvement.

A series of subsequent events then occurred in the following order:

August 5, 1942, a recurrence was noted in the soft tissue at the posterior extremity of the upper incision. This was widely excised.

October 16, 1942, two nodules were noted midway down the cervical border of the trapezius muscle. These were excised along with all the skin of the neck and the contents of the posterior triangle and the defect was covered with a large dermatome split thickness graft.

August 23, 1946, no further evidence of disease has been noted to date.

CASE 2. No. 4302. A white male, aged 69 years, was admitted July 9, 1942. Patient stated that a

rapidly progressing lesion had been present on the lower lip for only 1 year.

On examination the entire lower lip including both commissures of the mouth, was involved by a fungating mass firmly attached to the mandible. Conglomerate nodes were present in both of the submental and the submaxillary spaces and were also adherent to the mandible. Biopsy revealed an epidermoid carcinoma, grade 1. Roentgenograms revealed no evidence of actual mandibular destruction or pulmonary metastases.

On July 14, 1942, an *en bloc* resection of the lower lip, the anterior portion of the right horizontal ramus of the mandible, and all of the left horizontal ramus of the mandible was combined with a left total neck dissection. On pathological examination a tumor was found growing diffusely in the submaxillary space but none of the jugular nodes was involved. The postoperative course was uncomplicated.

On August 14, 1942, a left supraomohyoid neck dissection was done. Capsular invasion of the involved lymph nodes was noted microscopically with wide periosteal involvement. There was no demonstrable invasion of the jaw. Convalescence occurred without incident.

During follow-up a recurrence was noted adjacent to the anterior end of the left mandible. This was excised January 29, 1943.

Plastic repair of the face defect had been begun August 5, 1942, and was finally completed September 3, 1944; a skin tube swung from the chest wall was used with a satisfactory cosmetic and functional result. The patient remained free of any evidence of disease, but expired rather suddenly at home of pneumonia on April 30, 1945.

CASE 3. No. 5471, white male, aged 76 years, was admitted July 29, 1943. One year before he had had a "cancer" removed from lower lip. A mass had been noted below the left jaw 2 months prior to admission. A small defect was present on the vermilion border of the left side of the lower lip without evidence of residual disease. An ulcerating mass filled the left submaxillary region and was densely adherent to the mandible. There were no other palpably enlarged nodes. A biopsy revealed grade 1 epidermoid cancer. Roentgenograms showed an area of bone destruction along the inferior border of the left horizontal ramus of the mandible. The lungs appeared to contain no metastases.

A resection of the left mandible was combined with a supraomohyoid neck dissection on August 7, 1943. A tracheotomy was not done at the time of resection. However, about 5 hours later the patient developed marked stridor and a tracheotomy was done on the ward. The postoperative course thereafter was uncomplicated.

On examination of the operative specimen, disease was found only in the large ulcerated submaxillary node. The clinically noted bone invasion was confirmed and extensive periosteal involvement was present. The patient remained well until April 14, 1944, at which time a metastatic node was found in

the right (opposite) submaxillary space. It measured 2.5 centimeters in diameter when first seen and was moderately adherent to the inferior border of the right mandible. A supraomohyoid neck dissection was done and at the point of attachment of the node to the mandible several millimeters' thickness of bone was also removed.

The postoperative course was uneventful and the patient remains well 2 years and 6 months later.

CASE 4. No. 5725. A white female, aged 83 years, was admitted to the hospital October 13, 1943. She had developed a lesion at the left corner of the mouth 18 months prior to admission, and had been treated with radium. At the time of treatment to the primary lesion a small lump was already noted in the left submaxillary space. A few x-ray treatments had been given without apparent effect. On admission a scar without evidence of persistent disease was present adjacent to the left commissure of the mouth on the upper lip. The left submaxillary space and upper neck were filled by a large, deeply cratered mass fixed to the mandible and deeper neck structures and measuring 8 centimeters in diameter. The common and internal carotid arteries were palpably free of the mass. There was marked trismus and pain in the jaw. Biopsy of the crater was reported epidermoid cancer, grade 1. A roentgenogram of the chest revealed no metastatic foci in the lungs. Films of the mandible showed erosion of the inferior border of the left horizontal ramus by the tumor. Initial impression was that symptomatic treatment alone was indicated; however, the patient pled so fervently for removal of the tumor that it was finally decided to attempt this.

On October 25, 1943, a resection of the left mandible and node dissection was done. It had been intended to confine the dissection to the upper neck; however, small but grossly involved nodes were noted along the course of the internal jugular vein. The patient had been doing very well up to this point and it was decided to complete the neck dissection with removal of the sternomastoid muscle and internal jugular vein. During this part of the procedure the endotracheal tube slipped above the glottis, and either as a result of cord spasm or laryngeal edema the airway was shut off completely and marked cyanosis was noted. A tracheotomy was hastily done but a sharp though transient drop in blood pressure occurred. The patient never fully regained consciousness and expired about 20 hours after operation. An autopsy (exclusive of a brain examination) failed to reveal any decisive cause of death. Examination of the operative specimen revealed metastatic involvement of the preauricular, submaxillary, and upper jugular lymph nodes.

CASE 5. No. 6689. A white male, aged 36 years, was admitted to the hospital August 23, 1944. He had noted a pea-sized lesion of the vermilion border of the lower lip 2 years prior to admission. This tumor was treated with roentgen therapy 1 year later and rapidly disappeared. A mass was noted in the right submaxillary region 8 months before ad-

mission with subsequent marked increase in size. On examination a small scar was noted to the right of the midline of the lower lip without evidence of persistent disease. The right submaxillary space was filled by a mass measuring 6 centimeters in its greatest diameter, solidly fixed to the horizontal ramus of the mandible. The overlying skin was thin, discolored and adherent. No other nodes were palpable. Routine laboratory studies were unremarkable and an x-ray film of the chest failed to reveal any evidence of pulmonary metastases. Roentgenograms of the mandible revealed no architectural changes. An aspiration biopsy of the mass was reported "epidermoid carcinoma." On September 1, 1944, a right radical neck dissection with resection of the right mandible and tracheotomy was performed without untoward event. The pathologist reported epidermoid carcinoma, grade 2, metastatic only to the single large submaxillary node though 77 negative nodes were found in the specimen. There was extensive periosteal involvement. The patient's postoperative course was entirely satisfactory, and he was discharged from the hospital September 17, 1944, his sixteenth postoperative day. He was last seen in follow-up on October 11, 1946, and presented no evidence of recurrent or metastatic disease.

CASE 6. No. 7082. A white male, aged 71 years, was admitted to the hospital December 13, 1944. Approximately 7 months prior to entry he had noted a blister of the lower lip which had progressed rapidly. He received roentgen therapy without apparent effect. Four months before admission a mass had appeared in the left submaxillary area. This had increased in size eventually ulcerating through the skin. On admission the entire lower lip, excepting the base, was involved by an ulcerating mass measuring 7 centimeters in transverse diameter extending into the left buccal commissure. A left submaxillary mass measuring 4 centimeters in diameter was present. This was firmly attached to the mandible and had ulcerated through the overlying skin. No other adenopathy was present. Biopsy specimen revealed epidermoid carcinoma grade 2. X-ray examination revealed no evidence of mandibular destruction or pulmonary metastasis. An excision of the lower lip was carried out on December 19, 1944. On January 15, 1945 a left mandibular resection and a suprahyoid neck dissection were done. Though the procedure presented no unusual difficulty, the patient's blood pressure dropped alarmingly on several occasions requiring rapid administration of blood. As a result of this, pulmonary edema supervened and a large amount of pink froth was suctioned off from the trachea. Rapid digitalization was accomplished and was followed by an uneventful course.

On February 25, 1945 a node was noticed in each subdigastric area, and on aspiration biopsy these were found to contain epidermoid carcinoma. On March 1, 1945, a radical neck dissection was completed on the left. Two weeks later, March 16, 1945, a right radical neck dissection was done. Marked congestion and edema of the head structures lasting



more than a week followed removal of the second internal jugular vein but produced no other untoward effects.

A total of 10 nodes were found to contain disease in the several dissections. None of these was from the lower neck. There was extensive involvement of the periosteum but no invasion of the cortex of the left horizontal ramus of the mandible. The patient is now in the process of having a lower lip constructed, and 19 months following the last dissection remains free from evidence of disease.

CASE 7. No. 6971. A white male, aged 72 years, was admitted November 13, 1944. A lesion of the lower lip had been present no more than 1 year (history felt to be very unreliable). No previous treatment. Examination revealed a bulky foul lesion involving the entire lower lip fixed to the mandible and extending well into the substance of the left cheek. Bilateral extensive submaxillary adenopathy also fixed to the mandible and ulcerated through the skin on the right was present. Pathological diagnosis, epidermoid carcinoma, grade 1. Some erosion of the inferior border of the right horizontal ramus of the mandible was noted on x-ray examination. There was no roentgenologic evidence of pulmonary metastasis. The patient was given a preliminary course of anti-inflammatory x-ray therapy and on December 20, 1944, an *en bloc* removal of the lower lip, a portion of the left cheek and both horizontal mandibular rami was combined with a bilateral suprahyoid neck dissection. The laboratory reported involvement of 9 of 40 nodes found on the right and 4 or 5 found on the left. Node capsular invasion was present generally. A skin tube was begun on the chest wall for eventual repair of the defect, and the patient was discharged from the hospital January 24, 1945. He was readmitted March 14, 1945, with nodes in both jugulodigastric areas.

On March 29, 1945 a total neck dissection was completed on the right with removal of the internal jugular vein. Minimal lobular pneumonitis complicated the postoperative course but responded well to penicillin therapy. Seven of 27 nodes found were involved by metastatic disease. On April 18, 1945, a total left neck dissection was completed without untoward incident. The left internal jugular vein was also removed. Two of thirty-three nodes were involved making the astounding total of twenty-two involved nodes out of a total of 75 found in both sides of the neck.

Apart from marked edema of the conjunctiva, face, tongue and larynx incident to removal of the second jugular, all went well and the patient was discharged from the hospital improving on May 7, 1945, without any further evidence of disease. On May 13, 1945, the patient died suddenly of causes unknown.

CASE 8. No. 7245. A white male, aged 61 years, was admitted to the hospital February 19, 1945. A progressively enlarging ulceration of the left buccal mucosa had been noted for 5 years. No treatment had ever been applied. Six months previous to ad-

mission a mass had appeared below the left mandible. At the time of admission a large exophytic lesion of the left buccal mucosa measuring 6 centimeters in diameter was found. It extended from the oral commissure to the angle of the mandible and from the upper to the lower gingiva. It had penetrated the full thickness of the cheek ulcerating through the skin in one area. The left submaxillary space was occupied by a bulky mass to centimeters in greatest diameter and fixed to the mandible. Ulceration through the thinned out skin overlying the node mass appeared imminent. There was no other palpable lymphadenopathy in either side of the neck. Biopsy was reported epidermoid carcinoma, grade 1. Roentgenograms revealed erosion of the posterior alveolar aspect of the mandible. There was no evidence of pulmonary metastases.

On February 23, 1945 section of the left cheek and left mandible was combined with a left radical neck dissection. Pathological examination of the specimen revealed a well differentiated epidermoid carcinoma with well marked locally invasive properties which had metastasized rather widely to four cervical nodes, two of these being in the jugular chain. There was no invasion of the mandible noted. The postoperative course was entirely uneventful.

Clinic follow-up was unremarkable until November 11, 1945, at which time a swelling was noted in the left temporozygomatic region and a 2 centimeter mass appeared just beneath the mastoid. Aspiration biopsy specimens from both areas showed epidermoid carcinoma. This recurrence was considered to be beyond the scope of surgical removal and a course of roentgen therapy was instituted. Died May 12, 1946.

CASE 9. No. 7328. A white male, aged 69 years, was admitted to the hospital March 19, 1945.

In 1938 a diagnosis of "cancer of the left tonsil" was made and the patient was given a course of roentgen therapy, with complete disappearance of the tonsillar mass. In 1939 a "lump" appeared superficial to the angle of the left lower jaw. This was treated with x-ray in 1940, with temporary regression. Later increase in size resulted in a second series of roentgen treatments in 1943, followed by no perceptible diminution in size. During the year prior to admission the mass on the mandible had again begun to enlarge. On examination no trace of a primary tumor remained anywhere in the oral cavity or pharynx. Overlying the angle of the left mandible and fixed to it was a rounded mass 4 centimeters in diameter. The adjacent skin was attached to the mass and showed moderate secondary irritation changes as evidenced by complete epilation, achromia, and loss of elasticity of the skin. There was no other palpable adenopathy present. An aspiration biopsy of the mass revealed "epidermoid carcinoma." Roentgenograms showed erosion of the mandible beneath the tumor. There was no evidence of pulmonary metastases.

On March 3, 1945, the left mandible was resected in conjunction with a left total neck dissection.

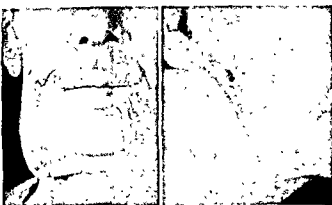


Fig. 1. Case 1. Metastases from healed lesion of the right buccal mucosa before combined jaw resection neck dissection and following dermatome graft of the entire one side of the neck for postoperative recurrences. The outline of the left carotid vessels is easily seen.

Careful pathological examination of the specimen failed to reveal any other involved nodes other than that represented by the mass at the crossing of the facial vessels. There was mandibular invasion present. The postoperative course was unremarkable except for poor healing in the area showing irradiation changes with subsequent formation of a small salivary fistula.

The patient has remained well for a period of 18 months and is at present in the process of having the salivary fistula repaired.

CASE 10. No. 7358. A white male, aged 56 years, was admitted to the hospital March 27, 1945.

In January, 1944, a small tumor of the left side of the vermillion border of the lower lip had been treated with radium with good result. In August, 1944 (7 months before admission), "lumps" were first noted in the left submaxillary area. On examination a small scar was present at the site of the original primary growth with no evidence of persistent disease. A large mass was present, filling the entire left upper neck; it was fixed to the horizontal ramus of the mandible, to the deeper structures of the neck in the region of the hyoid bone and had ulcerated through the skin. It measured 8 centimeters in its greatest diameter. There were no other palpably enlarged nodes. Roentgenograms of the mandible revealed no evidence of bone invasion nor did those of the chest show any metastatic involvement. An examination of aspiration biopsy specimen from the mass revealed "epidermoid carcinoma." On April 2, 1945, a resection of the left mandible and left total neck dissection was done. The left wing of the hyoid bone and small musculature in that region were also removed down to the mucosa of the pharynx. Due to unusual vascularity four transfusions were given in the operating room. The patient's condition remained stable until all return through the left internal jugular system had been severed at which time he developed irregular stertorous respirations and a very rapid pulse of very variable strength. A spinal manometer attached to



Fig. 2. Case 8. Showing ulceration of a carcinoma of the buccal mucosa through the skin of the lip with impending ulceration of the nodes through the skin of the neck. The large buccal lesion is seen in the upper right portion of the specimen.



Fig. 3. Cases 11 and 12. Extensive paramandibular metastasis with oral fistulas secondary to carcinoma of the lower lip. The resulting defects are left for subsequent reconstruction accomplished with tube grafts.

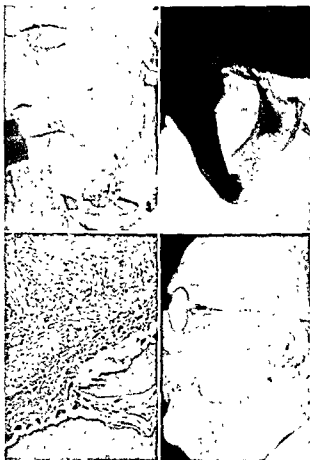


Fig. 4. Case 3. Large submaxillary mass secondary to a small healed carcinoma of the lower lip. Invasion of the mandible is visible on the roentgenogram and the photomicrograph. The necessary wide sacrifice of soft tissue and jaw anteriorly somewhat diminishes the satisfactoriness of the final cosmetic result.

a previously placed needle in the third lumbar interspace (in conjunction with another study) registered a cerebrospinal fluid pressure of 750 millimeters of water which was still rising. After 150 cubic centimeters of spinal fluid had been removed, vital signs promptly returned to normal and the cerebrospinal fluid pressure dropped to 150 millimeters of water. The first two postoperative days were unremarkable and on the third day a Levine tube was inserted for feedings. An absence of a gag reflex was noted during its passage. Vomiting occurred about one-half hour after each feeding and the feedings were discontinued. Aspiration pneumonia supervened, however, and progressed, with death occurring on the seventh postoperative day.

The pathological report on the operative specimen revealed epidermoid cancer present in 2 of 77 nodes found, with a tumor thrombus present in the internal jugular vein. At autopsy extensive necrotizing pneumonitis was found. In addition marked dilatation of the veins overlying the left cerebral

hemisphere and numerous thrombi in the left subdural veins were noted.

**CASE 11.** No. 7493. A white female, aged 38 years, was admitted to the hospital May 11, 1945. She had developed a sore on the lower lip 10 months before admission. She had been treated with "black paste" and the growth disappeared. One month prior to paste treatment and 8 months before admission patient noted nodules in substance of left cheek and below left jaw. On examination a small scarred defect was present on the vermillion border of the left side of the lower lip indicating the site of the original primary tumor. Just lateral to the left commissure of the mouth and extending well into the substance of the left cheek was a hard indurated mass with ulceration through the skin and buccal mucosa producing a through-and-through fistula. The left submaxillary space was filled by a hard mass firmly attached to the mandible with fistulas into the floor of the mouth. In the right submaxillary space was a solitary 2 centimeter node attached to, but slightly movable on, the horizontal ramus of the mandible. The pathological report was, epidermoid carcinoma, ungraded. Roentgen films of the mandible showed no bone destruction and those of the chest were negative for evidence of bone metastasis.

On May 16, 1945 a wide resection of the left cheek and left mandible was combined with a left radical neck dissection. The pathologist reported that there were no involved nodes below the submaxillary group. There was wide periosteal involvement but no demonstrable bone invasion. The postoperative course was unremarkable.

On June 14, 1945, a right radical neck dissection was accomplished with removal of the second internal jugular vein. Only one node of 55 was found to be involved. The patient is now in process of plastic reconstruction and when last seen September 1, 1946, presented no evidence of disease.

**CASE 12.** No. 1098. A white male, aged 28 years, was admitted to the hospital June 4, 1945. A lesion of right lower lip of 4 years' duration had been treated with roentgen therapy in January, 1944. Eight months later right submaxillary masses developed. On admission patient presented a small scar on the lower lip. The right submaxillary and both submental areas were filled with a foul ulcerated mass fixed to the mandible over a wide area. The disease appeared to be localized to this area inasmuch as there was no other palpable lymphadenopathy and a roentgenogram of the chest showed no metastases. Biopsy specimen was reported epidermoid carcinoma, grade 1.

On June 6, 1945 a resection of the right mandible and considerable surrounding soft tissue was combined with a right radical neck dissection. It was possible to appose the mucosa but not the skin. The large skin defect was covered with a dermatome graft. The graft took well and the postoperative course was progressing satisfactorily until the 10th postoperative day, when the patient (a known epileptic) became very unco-operative, refused all

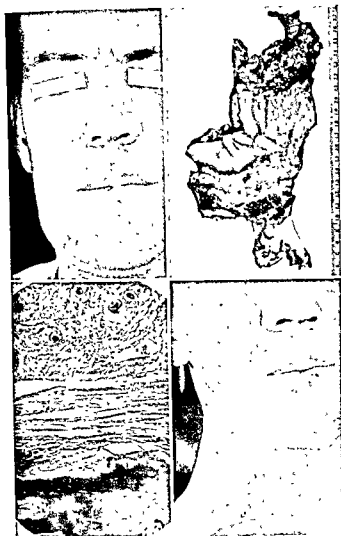


Fig. 5. Case 5. Submaxillary mass (derived from a carcinoma of the lower lip) removed with the overlying attached skin. The markers visible on the specimen are placed for the better orientation of the pathologist. Tumor is visible invading along the periosteum though the mandible itself is not yet involved. The ability to spare the anterior portion of the right mandible considerably improves the cosmetic result.

feedings, removed his dressings, and tore loose the mucosal suture line with his fingers. It became necessary to remove him to a hospital for the mentally ill. Microscopic examination of the specimen showed no other node involvement beyond that presented by the conglomerate mass of disease. There was extensive periosteal invasion but no actual invasion of the mandible was seen. An oral fistula persists, but there has been no evidence of recurrent or metastatic disease 16 months later.

Among the 12 patients operated on there were 2 postoperative deaths. One of these occurred from shock in an 83 year old patient in very poor general condition. The other took place from aspiration pneumonia, subsequent to the regurgitation and bronchial aspiration of tube

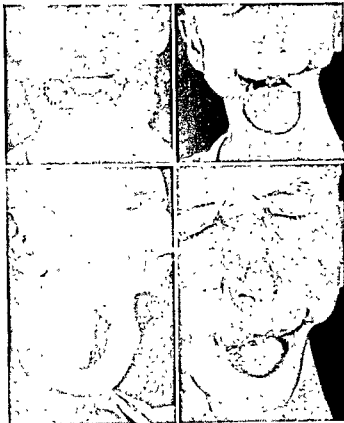


Fig. 6. Case 2. Extensive carcinoma of the lower lip with submaxillary and submental node involvement bilaterally; *en bloc* removal of the diseased area with most of the horizontal portion of the mandible; entire defect reconstructed with tube graft brought from upper chest wall.

feedings. Autopsy findings in this patient revealed brain changes, which were considered to be of etiologic significance in the patient's inability to handle his feedings. The patient's operative course would relate these to internal jugular vein resection. Apart from the 2 deaths there were no other serious complications.

Postoperative temperatures have usually ranged from 101 degrees F. to 103 degrees F., for the first 3 to 4 days, probably as a result of the natural contamination of so large a wound. No serious infections ensued though occasional collections of seropurulent material, particularly in the pterygoid region, did require drainage. Significance is attached to the fact that most of the patients treated presented lip cancer. It is unlikely that many cases of cancer of the tongue, floor of the mouth, *et cetera* will be found suitable for such an operation as most of these will present other manifestations of more widespread dis-

case at the stage of fixation of the local nodes to the mandible. Our one case having had a primary cancer of the tonsil was definitely bizarre in its behavior.

There have been three postoperative recurrences. Only one of these occurred among the patients whose disease derived from a carcinoma of the lip (Case 2). In this instance the probability of recurrence was anticipated, for at one point in the procedure, a small but involved lymph node was inadvertently cut across. The recurrence was carefully sought for during subsequent follow-up examinations, and when it appeared was apparently successfully treated by wide excision. The other two recurrences (Cases 1 and 8) took place presumably on the basis of microscopic permeation of lymphatics at some distance from the palpable limits of the disease in patients whose disease it was felt had been widely circumscribed at operation. Both of these represented carcinomas of the buccal mucosa. It is our belief that these recurrences when they take place in an area still amenable to wide surgical removal should be attacked in that manner even though there may be several. Widespread recurrence would rarely lend itself to surgical extirpation.

In 7 patients the disease was apparently confined to the area of obvious clinical involvement as indicated by careful pathologic examination of the specimen and follow-up examination to date. In the remaining 5 however, either examination of the specimen (where total unilateral dissection was permissible) or the subsequent clinical course (where the dissection because of other considerations was subtotal in extent) revealed occult metastatic disease that had been unsuspected at the time of operation. This should certainly justify the accomplishment of complete node dissections whenever feasible on other counts. As might well be anticipated 3 of the 4 patients who presented simultaneously active disease in both the primary tumor and the lymph node sites fell into the group having more widespread node involvement than was clinically apparent. Carcinoma which within a short interval is present in both its primary and secondary sites is silently declaring its aggressiveness.

An apology for removal of the mandible in those cases failing to show roentgenologic evidence of actual bone invasion hardly seems necessary. That bone invasion will occasionally be microscopically demonstrable in spite of roentgen report to the contrary is well exemplified by Case 1.

In the absence of bone invasion, however, wide periosteal involvement has been the rule in our experience when node masses are fixed to the jaw. It is doubtful whether anything less than resection of the mandible is justified under such circumstances.

The duration of follow-up in these patients is still too inadequate to draw any definite conclusions as to actual long term survival. Of the 10 patients surviving operation, 2 have died of intercurrent disease 27 months and 1 month, respectively, from the date last treated and at the time of death were free of any evidence of carcinoma. One died with a recurrence treated by x-ray which developed 7 months following operation. Seven are living and free of any manifestation of recurrent or metastatic cancer by actual examination 45, 30, 25, 19, 18, 16, 16 months, respectively. Certain statements regarding the group surviving free of disease are justified, however, since it will be readily admitted that what life remains for these patients untreated is pitiful in the extreme. Radiation therapy at this stage of the process accomplishes little palliatively, and cures must be very rare; operative treatment can be accomplished with an acceptable mortality. The survival of 7 patients to date has unquestionably justified the effort. Since carcinomas of the type here discussed as a rule give evidence of recurrence or metastasis within 1 year of treatment, there is reason to expect that a fair percentage of those surviving to date free of disease may continue to do so.

#### SUMMARY

1. Twelve patients are presented in whom a combined jaw resection and neck dissection were carried out for carcinoma metastatic to the upper cervical lymph nodes which secondarily involved the mandible.

2. A natural selection of such cases is indicated by the tendency which some tumors have for prolonged local aggressiveness before

dissemination beyond the limits of surgical removal occurs.

3. Considerations relative to the management of these patients are discussed.

4. The results to date, 2 postoperative deaths, 1 patient died with recurrence, 2 deaths from intercurrent disease without recurrence and 7 patients alive without recurrence from 16 to 45 months after the treatment, suggest an ultimate prognosis far differ-

ent from the relatively hopeless outlook formerly existing for these patients.

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## THE MANAGEMENT OF PLACENTA PREVIA AT THE CHICAGO LYING-IN HOSPITAL

A Review of 325 Cases during 1931 to 1945

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PLACENTA previa is still one of the major complications of pregnancy and labor but modern management has robbed it of much of the terror of past decades. Early diagnosis, hospitalization, rational obstetrical treatment and the ease of blood and plasma transfusions have decreased the mortality to the vanishing point in our large institutions. However, mortality statistics from the country at large assign 23 per cent of maternal deaths to hemorrhage and at least half of these deaths are due to placenta previa. Many other women who have placenta previa succumb from infection or embolism and find their way into our statistics as puerperal infection deaths. Thus, it is a fair estimate that 15 to 20 per cent of our maternal deaths are the result of placenta previa.

#### ETIOLOGY

The cause of placenta previa is still unknown. The most plausible theory is that the abnormal implantation probably results from a failure in the mechanism of transportation of the fertilized ovum. Normally, fertilization occurs in the fallopian tube. The fertilized ovum is moved into the uterine cavity at the end of 72 hours but remains free and unat-

tached for the next 4 or 5 days. Normally, the small vesicle remains high in the uterine cavity where it ultimately attaches itself to the endometrium. If environmental forces move the small vesicle downward so that it finally attaches itself in the region of the internal os, placenta previa must result. Many factors may operate to transport the ovum to this abnormal location.

Morton has called attention to the increased decidual response in the region of the internal os in a patient with placenta previa. It is suggested that this marked decidual development in contrast to the meager response high in the corpus may have predisposed to the abnormal placental site.

The fertilized ovum is at no time a free agent but depends on environmental forces to move it down the tube and into the uterus. It cannot select the ideal implantation site but it must attach itself to that location where it finds itself at the time of implantation. This locality may be the abdomen, the fallopian tube, the uppermost portion of the anterior or posterior walls of the uterus or in the region of the internal os. Placentation occurs at the site of attachment. The degree of previa will depend on how close to the internal os the implantation occurs. Abnormal uterine motility, multiparity, decidual development may pre-

TABLE I.—INCIDENCE OF PLACENTA PREVIA  
1931 TO 1945

Degree of Previa	Complete	Partial	Incomplete		Total
			Marginal	Low lying	
No	88	43	121	73	325
Per cent	27.1	13.2	37.2	22.5	100
No placenta palpable on first examination	6	2	15	10	33
Average age	30.3	28.0	28.0	29.7	

Total deliveries, 40,961

Placenta previa, 325

Incidence, 0.79 per cent

dispose to placenta previa only as they may influence the movement of the ovum in the uterine cavity.

The surface area of the placenta may favor a low implantation. In placenta membranacea placental tissue covers most of the chorion as a result of a failure of villi underneath the decidua capsularis to atrophy. Obviously, all or a portion of the internal os will be covered by placenta. Succenturiate lobes may cover a part or all of the os. Lastly, an abnormally large placenta may impinge on the lower uterine segment simply because of its size.

## INCIDENCE

The incidence of placenta previa varies in different institutions, from 0.63 to 2 per cent. In a period of over 14 years, May, 1931 to July 1, 1945, 40,961 patients were delivered in the new Chicago Lying-in Hospital and placenta previa was present 325 times, an incidence of 1 in 126 deliveries or 0.79 per cent (Table I). During this period more than 80 per cent of all deliveries in Chicago occurred in hospitals so that the figure represents a fair index of the frequency of this complication. Furthermore, all patients who had bleeding during the last trimester of pregnancy were examined, thereby establishing a diagnosis ac-

The older literature emphasized the fact that placenta previa was a complication of multiparity. The preponderance of large families in these statistics accentuated this idea. The large family is becoming more and more rare and the "grande multipara" is disappearing. However, in Table II, it can be noted that although the deliveries were

TABLE II.—PARITY OF PLACENTA PREVIA  
1931 TO 1945

	Complete	Partial	Incomplete		Total	Per cent
			Marginal	Low lying		
Gravida I	14	13	36	10	81	15.1
II	21	12	32	10	84	16.0
III	17	7	18	13	55	16.9
IV	13	2	8	11	34	10.5
V	8	2	12	4	26	11.1
over V	15	7	15	7	44	13.5
Total	88	43	121	73	325	100.0

	Primigravida		Multigravida	
	No.	Per cent	No.	Per cent
Total deliveries	18,619	45.5	22,342	54.5
Placenta previa	81	25.0	243	75.0

almost equally divided between primigravidas (45.5%) and multigravidas (54.5%) 3 out of 4 patients with placenta previa were multigravidas. The distribution of the patients in relation to their parity is indicated in Table II. Childbearing predisposes to the development of placenta previa but the reason for this fact is still obscure.

## PATHOLOGY

The abnormal location of the placenta results in a pathologic placental uterine relationship which is responsible for the hemorrhage and the greater vulnerability to trauma and infection. When the placenta is high up in the corpus the placental site develops in the thick myometrium of this region. The vascularization incidental to these changes does not interfere with the integrity of the uterus. A thick decidual buffer zone between the placenta and the uterine wall facilitates the physiologic separation in the third stage of labor. Placental attachment is not disturbed by the uterine motility associated with the development of the lower uterine segment in late pregnancy and dilatation of the cervix in labor.

The lower uterine segment and the cervical region are not adapted to placental attachment. This portion of the uterus is the inactive passage zone between the contractile

TABLE III.—ONSET OF BLEEDING IN PLACENTA PREVIA 1931 TO 1945

Gestation Weeks	Complete	Partial	Incomplete		Total	Per cent
			Marginal	Low lying		
Less than 28	13	9	12	5	39	12
28-30	8	6	4	5	23	16
30-32	9	2	11	8	30	
32-34	13	5	13	8	39	35
34-36	10	2	15	7	34	
36-38	12	5	16	7	40	37
38-40	17	8	22	20	67	
40-42	5	4	25	10	44	
42-44	1	2	3	3	9	
Total	88	43	121	73	325	100
Average	31.9	34.0	33.0	33.7	32.6	

corpus above and the vagina below. The walls composed largely of elastic tissue fibers and few muscle cells are designed to withstand considerable distension and stretching. The vascularization of these walls brought about by placental attachment interferes with their normal integrity. Minor manipulations through the cervix may result in extensive lacerations of the pathologic lower uterine segment. The physiologic changes incidental to effacement and dilatation must necessarily interfere with the attachment of the placenta resulting in minute or more extensive separations which are responsible for the painless bleeding characteristic of placenta previa. In that effacement is a process which may extend over a period of days or several months, episodes of bleeding will recur. The initial hemorrhage may occur early in the last trimester or it may be postponed until the onset of labor but bleeding is inevitable in placenta previa.

The proximity of the placental site to the vagina which always harbors organisms and to manipulations necessary for delivery increases the hazard of infection. Trauma, too, invites infection. The loss of blood favors its development. It has been pointed out that fewer women die of blood loss primarily today but the incidence of infection has not been reduced greatly. There is a greater hazard of thrombosis and embolism in placenta previa.

TABLE IV.—AMOUNT OF BLEEDING IN PLACENTA PREVIA 1931 TO 1945

	Complete	Partial	Incomplete		Total
			Marginal	Low lying	
None (elective cesarean section)	11	1	6	4	22
Profuse	10	4	15	6	35
In shock	2	2	2	2	8
Elective laparotomies for other indications than placenta previa					
Contracted pelvis	8				
Previous laparotomies	6				
Toxemia	4				
Medical	4				
Total	22				

The thrombi in the sinuses of the placental site located in the lower uterine segment are more easily mobilized. The closer association of the placental site and sources of infection favors thrombophlebitis and embolism.

## SYMPTOMS

Painless bleeding in the later weeks of pregnancy is pathognomonic of placenta previa. The initial hemorrhage may occur early in the gestation and undoubtedly some abortions are the result of low implantations. These patients never find their way into the statistics on placenta previa. In 39, or 12 per cent, of our patients the initial bleeding occurred prior to 28 weeks, in 53, or 16 per cent, sometime between the twenty-eighth and thirty-second week (Table III). Thus, in 28 per cent of the patients the presence of the placenta in the region of the cervix manifested itself prior to fetal viability. This fact accounts for the high fetal mortality for few babies survive prior to 28 weeks and not many more prior to 32 weeks' gestation. The degree of encroachment of the placenta on the internal os is not the most important factor in determining the time of onset of bleeding. It is apparent from our figures that the bleeding in complete placenta previa began a week or two earlier than in incomplete placenta previa. Marginal or low insertion of the placenta may not result in any bleeding prior to the onset of labor. The onset of efface-



ment of the cervix as well as the uterine motility which is responsible for it rather than the degree of placental coverage of the internal os determines the onset of bleeding.

The severity of the hemorrhage will be determined by the extent of the previa and whether or not the patient is in labor. The initial bleeding is rarely alarming and may subside quickly. It may consist of a few drops or the blood may gush out for a moment. In that the bleeding is dependent on a tear through maternal sinuses by minute separations, the size of the vessel will determine the blood loss. The initial bleeding usually subsides quickly in the patient not in labor, but bleeding will recur in days or weeks. A small amount of bleeding may persist for days to give way to a dark serosanguineous discharge. The onset of labor brings on rapid cervical effacement and dilatation and the hemorrhage becomes more profuse or if it has subsided it will recur. Again, the hemorrhage may be moderate or profuse depending on the rapidity and the extent of placental separation.

In Table IV, it will be noted that 35 patients had a profuse hemorrhage prior to their examination and treatment. Eight more patients were in shock when they entered the hospital. Thus, in 13 per cent or in 1 out of 8 patients the blood loss was serious prior to the institution of treatment. In 22 elective cesarean sections that were performed for indications other than placenta previa, the placenta was encountered in the lower uterine segment covering part or all of the os. In these patients the abnormal location of the placenta incited no bleeding. It is probable that had labor intervened prior to the operation, bleeding would have occurred incidental to effacement and dilatation.

#### DIAGNOSIS

The diagnosis of placenta previa must rest to a large extent on its pathognomic symptom—painless bleeding in the last trimester of pregnancy. This warning hemorrhage, small or considerable in amount, must invariably call attention to the likely presence of the placenta in an abnormal location. Every patient who complains of bleeding is referred to the hospital for a diagnosis as to the cause. After it has been made certain that blood is available read-

ily in the event transfusion should be indicated, the patient is examined vaginally.

If the cervix is partially effaced and the os admits the finger there is no difficulty in palpating the placenta when it covers part or all of the os. In the low lying placenta the edge can be palpated easily if it reaches within several centimeters of the internal os. In the absence of the placenta the thin membranes are the only barrier between the palpating finger and the presenting part. No anesthesia is necessary for this simple examination. An antiseptic lubricant, such as merthiolate in glycerin, may add to the ease with which the examination is carried out and to its safety.

Abdominal examination may reveal a transverse presentation or the presenting part above the inlet of the pelvis. The presence of the placenta in the lower uterine segment may interfere with the normal accommodation of the head in the pelvis, particularly if the latter is small or abnormal. The abnormal presentation and the failure of engagement of the presenting part is additional evidence of placenta previa in the patient with painless bleeding.

Direct or indirect visualization of the placenta has been used in the diagnosis of placenta previa. Snow and Rosensohn, Brown and Dippel have described a method of filming the uterus to emphasize the variable densities of the soft tissues. If the placenta is ideally located its shadow can be visualized clearly on the x-ray plate in 3 out of 4 patients. The absence of a placental shadow does not rule out placenta previa. Ude, Weum, and Urner have injected radiopaque substances into the bladder and Prentiss and Tucker have used air to provide greater contrasts and the placenta has been visualized as an intervening shadow between the bladder and the presenting part. Both of these methods have been used experimentally at the Chicago Lying-in Hospital, but they have not become a part of our routine because they do not add appreciably to the management of this complication. Pelvic examination affords the opportunity to determine the degree of placenta previa, the state of the cervix, the adequacy of the pelvis and the fetal position. These findings are necessary in a decision as to the appropriate treatment.

In the differential diagnosis of placenta previa all causes of bleeding in the last trimester of pregnancy must be ruled out. We have kept a record for a 5 year period of all vaginal examinations for bleeding during the last 3 months of pregnancy and found placenta previa in 32 per cent of the cases. Many causes, most of them trivial, were responsible for the bleeding in the other patients. The bleeding in abruptio placentae is most often associated with pain but mild degrees of placental separation can occur in the absence of pain and marked uterine tenderness. Painless bleeding can occur from an abnormal cervix, the site of an erosion, a polyp, or, rarely, a malignant lesion. Vaginal varices may rupture and bleed. Trauma of the vaginal walls physiologically altered or inflamed as a result of a lower genital tract infection may result in bleeding. At times the painless bleeding may have its origin in the urethra and bladder or even the rectum. A careful vaginal examination combined with the visualization of the vagina and cervix by means of a speculum will identify the origin of the bleeding most often. Rarely, no cause for the bleeding can be found or the examination is inadequate to rule out placenta previa. In 33 patients no placental tissue could be palpated at the initial examination. However, when they returned to the hospital because of a recurrence of painless bleeding, sufficient changes had taken place in the cervix so that placenta could be palpated.

There are various degrees of previa depending on the extent that the os is covered by placenta at the time of the examination. Complete placenta previa is used to designate complete coverage of the os and incomplete placenta previa partial coverage. At times no placenta is palpable directly over the internal os but it extends into the zone of effacement and dilatation. As the lower uterine segment develops during the latter part of pregnancy and in labor, the dependent portion of the placenta may become separated and cause bleeding. These low insertions of the placenta must be considered as borderline placenta previas. Obviously, the relationship of the placenta and the internal os may vary as effacement and dilatation progress but clinically this classification will suffice. The term,

central placenta previa, which denotes that the os is covered by the central portion of the placenta, is no longer applicable for this diagnosis can be made only at cesarean section. Total coverage of the os by placenta at or near complete dilatation is encountered rarely on the large maternity services.

#### TREATMENT

The treatment of placenta previa has become standardized in the large institutions in recent years. Advances in medicine and in obstetrics have contributed to the present management. No one questions the fact that all patients who bleed in the last trimester of pregnancy should be sent to a hospital for diagnosis and treatment. There is no home treatment for this serious complication.

The treatment of an obstetrical complication identified with blood loss begins in the prenatal period. Each patient should have a careful blood study which should include the determination of the hemoglobin content, the cell volume, Rh reaction, and the Wassermann or Kahn. The patient in whom the hemoglobin remains under 10 grams in spite of iron therapy should be transfused before she goes into labor or suitable blood should be available readily. One cannot always guard against an excessive blood loss but facilities should be at hand for the restoration of blood with a minimum of time loss. Plasma should be available at all times but the armed services have emphasized recently what we have known for a long time that plasma does not replace whole blood in serious hemorrhage.

When blood has been made available and preparations for delivery are complete the patient should be examined vaginally. The state of the cervix should be determined, the presence of placenta over the os and the extent of coverage noted. If the os is free of placenta the adjacent walls of the lower uterine segment should be carefully explored for a low lying placenta. Position can now be determined. Lastly, one should evaluate the state of the soft parts and the size of the pelvis.

If no placenta is palpable, a speculum examination of the cervix may help to rule out the cause of the bleeding. In the absence of

TABLE V.—INITIAL MANAGEMENT FOR CONTROL OF BLEEDING IN PLACENTA PREVIA 1931 TO 1945

	Complete	Partial	Incomplete Marginal	Low lying	Totals
In labor, bag of waters ruptured	0	1	13	9	23
Artificial rupture of bag of waters	8 (1F)*	6	33	27	74 (1F)*
Ruptured bag of waters, bag	7 (1F)*	7	12	9	40 (1F)*
Ruptured bag of waters, bag, pituitrin	1	2	4	1	8
Ruptured bag of waters, pituitrin	2	2 (1F)*	12 (1F)*	6 (1F)*	22 (1F)*
Ruptured bag of waters, Willett's	0	3 (1F)*	7	4	14 (1F)*
Ruptured bag of waters, version	4 (1F)*	8	1	2 (1F)*	15 (1F)*
Laparotrachelotomy	63	13	31	14	121
Porro	8	1	3	3	15

\*F

placenta previa the patient may be sent home for the examination is unlikely to start labor prematurely.

The initial management of placenta previa is directed toward the control of further bleeding and the delivery of the patient by the most conservative procedure consistent with her safety. When a diagnosis of placenta previa has been established the termination of the pregnancy is indicated. It is recognized that in many patients the baby has not reached a period of development when it can survive out of the uterus. However, the continuation of the pregnancy is fraught with danger and has resulted in an increased hazard for the mother. The primary risk of hemorrhage can be combatted these days by keeping the patient in a hospital where blood is available readily. However, the increased hazard of infection in the presence of vaginal bleeding is still difficult to overcome. It is possible that the use of the new antibiotics prophylactically may some day alter our present routine that once placenta previa is diagnosed the patient should be delivered but that day has not arrived.

The initial management of our patients is summarized in Table V. In a very small number, 22 patients, or 7 per cent of the total,

TABLE VI.—TERMINATION OF LABOR IN PLACENTA PREVIA 1931 TO 1945

	Complete	Partial	Incomplete		Totals	
			Marginal	Low lying	No.	Per cent
Natural	1	13	41	35	90	15.6
Forceps	0	4	24	7	35	
Extraction	6	3	9	3	21	
Version+ extraction	4	6	10	4	24	
Craniotomy	3	1	3	1	8	
Laparotrachelotomy	66	13	31	16	126	
Porro	8	1	4	4	17	
Total	88	41	127	73	329	

labor was in progress when they were admitted to the hospital. Almost 93 per cent were not in labor but entered the hospital because of bleeding. All of our patients are cautioned about the importance of bleeding in pregnancy so that they are seen at the first warning bleeding. Rupture of the membranes sufficed to control bleeding in 98 instances although all but 8 of these patients had incomplete placenta previa. In 99 other cases some additional procedure had to be instituted. Again, in only 14 of these patients complete placenta previa was diagnosed. Thus, rupture of the membranes alone or combined with some other procedure was the initial treatment for the control of bleeding and the institution of labor in 197 patients or 60.6 per cent of this entire series. Cesarean section was the initial treatment in the remainder.

Complete placenta previa is treated by cesarean section. This method offers the best prognosis for the baby as well as for the mother. Abdominal delivery is indicated in incomplete placenta previa when there has been a serious blood loss; when the cervix is long and uneffaced, unripe so to speak; in the elderly primipara in whom the fetus is of great importance because the mother is near the end of her reproductive period; in the patient with a borderline or grossly inadequate pelvis.

At the Chicago Lying-in hospital the low or cervical cesarean section, laparotrachelotomy, is the operation of choice. It has been suggested that the classic operation would miss

the placenta in the lower uterine segment. There is an increased loss of blood if one encounters the placenta on the anterior wall in the lower uterine segment operation but average care, speed and dexterity will keep the blood loss at a minimum. Furthermore, bleeding from placental sinuses can be readily controlled by direct suture, thereby minimizing the possibility of continued bleeding. The entire placental site on the posterior as well as the anterior wall can be inspected easily and bleeding controlled by pack or suture if necessary.

Incomplete placenta previa can be managed in such a way that delivery can be completed through the birth passages in most instances. If the cervix is partially effaced and the os patulous the membranes are ruptured. This simple device will control bleeding in the majority of the patients by allowing the placenta to remain attached to the lower segment as retraction progresses. The presenting part may descend with the escape of the liquor amnii so that it more closely approximates the placenta exerting pressure upon it and helping to check bleeding. Lastly, the rupture of the membranes in a patient with a ripe cervix is the most effective method of inducing labor.

If simple rupture of the membranes does not suffice to control bleeding in incomplete placenta previa, the use of Willett's method can be considered. Scalp traction is effective for the control of bleeding. Willett's forceps or two tenaculae properly applied to the scalp will not result in serious trauma. The viable fetus will usually survive and the scalp damage can be treated. Traction should be applied to the forceps by some contrivance and the least amount of pull necessary to control the bleeding should be exerted. Usually  $\frac{1}{2}$  to 1 pound weight over a pulley will suffice.

Cesarean-hysterectomy has been reserved for patients admitted to the hospital potentially or obviously infected, in whom the termination of reproduction is no great loss. The removal of the uterus decreases the hazard of serious infection, for this organ can serve as the focus of a puerperal infection. Extraperitoneal operations, such as the Water's procedure, are of questionable value in these

patients because the abnormal location of the placenta leads to increased vascularity of the lower uterine segment and bladder. This would increase the difficulty for the approach to the baby is through this vascularized zone. There may be some other indication for hysterectomy such as neoplasms of the uterus. The operation is not difficult and with care the blood loss can be controlled. Recovery is usually uneventful.

Table VI presents a summary of the modes of delivery in our group of patients. Abdominal delivery was carried out in 143 or 44 per cent of the patients. Ninety-three patients delivered naturally and in 89 some operative procedure was necessary to terminate the delivery through the natural passages. Thus, more than half of the patients were delivered from below without mortality. This fact emphasizes the importance of individualizing the treatment of this complication.

Some of the accepted methods of treatment in placenta previa made honorable by tradition have no place in the modern hospital. They represented the best that were available in their day but progress has made them obsolete. They still appear in the standard textbooks of our time to confuse the student and practitioner.

Tamponade has no place in the treatment of placenta previa. Even as a temporary expedient to check hemorrhage it is ineffective and dangerous. Patients with placenta previa who are not examined are not likely to bleed to death. Thus, the patient who has bleeding in the later weeks of pregnancy should be referred to a hospital promptly. All examinations should be postponed until everything is in readiness to cope with any emergency.

The bag or colpeurynter can be discarded in the management of placenta previa. It provided a means of controlling hemorrhage but the manipulation incidental to the introduction of the bag and the subsequent delivery often resulted in trauma, infection, thrombosis and embolism.

The introduction of a foreign body in close proximity to the placental site increases the hazard of serious infection. Properly placed, bleeding will be controlled but labor must be initiated and hours may lapse before there is

TABLE VII.—THIRD STAGE OF LABOR IN  
PLACENTA PREVIA 1931 TO 1945

	Com- plete	Par- tial	Incomplete		Totals
			Mar- ginal	Low lying	
Laparotrachelotomy	74	14	35	20	143
Natural	0	18	67	40	143
Manual removal	5	11	12	3	36
Uterine pack	2	3	6	4	15
Postpartum hysterectomy	0	2	1	2	5

sufficient dilatation for the bag to pass through the cervix. The mechanism of labor may be abnormal because the period of the gestation is not favorable to the artificial termination of the pregnancy through the natural passages. Once the bag is in the vagina it must be removed promptly for it no longer acts as a tampon against the placenta. It actually plugs the vagina and much blood can accumulate behind it without the attendant being aware of the continued hemorrhage. When the bag has been removed spontaneous delivery of the child rarely follows. The accoucheur must deliver the baby by version and extraction or forceps. All of these manipulations carried out through a pathologic lower uterine segment, highly vascularized and easily traumatized must result necessarily in serious damage and infection. These factors contribute to increased morbidity and mortality in use of the bag for placenta previa.

Braxton Hick's version was a means of controlling hemorrhage at a sacrifice of the fetus. It was an expedient that had to be resorted to when other methods were less safe. There are several reasons why this method of controlling hemorrhage is hazardous. Braxton Hicks' version was the method of choice in the patient prior to or at the borderline of viability. Under such circumstances the cervix was usually long and at best partially effaced, dilated sufficiently to admit two fingers. The version is difficult under these circumstances even though the accoucheur has had considerable experience. Manipulations result in trauma to the placental area and increased likelihood of infection. Blood loss may be considerable during the process.

TABLE VIII.—SUPPORTIVE TREATMENT IN  
PLACENTA PREVIA 1931 TO 1945

Antepartum and intra- partum	Com- plete	Par- tial	Incomplete		Total
			Mar- ginal	Low lying	
Subcutaneous fluids	4	4	3	0	11
Intravenous fluids	5	6	4	7	19
1 transfusion	17	5	6	7	35
2 or more transfusions	1	1	2	1	5
Postpartum					
Subcutaneous fluids	19	7	22	11	59
Intravenous fluids	17	7	13	9	46
1 transfusion	32	17	21	13	83
2 or more transfusions	4	6	4	2	16

The version completed and bleeding brought under control heralds the onset of an indefinite period during which labor must be initiated and complete dilatation secured. In this period of pregnancy the uterus may be unresponsive and uterine contractions desultory. Hours may elapse before the patient can be delivered during which time trauma and infection are real dangers. The delivery of the fetus may be followed by an abnormal placental stage.

It is apparent that the period of pregnancy best suited for delivery by Braxton Hicks' version is the least favorable for a delivery from below. The unripe cervix, the pathologic lower uterine segment, and the unco-ordinated uterine motility may all combine to make the delivery of even a small fetus a virtual nightmare. The highly vascularized cervix may tear like wet blotting paper. Infection may be difficult or impossible to control. Many obstetricians have hesitated to do a cesarean section in the patient with placenta previa in whom the fetus is of questionable viability. The decision concerning the mode of delivery should rest on the degree of placenta previa, the state of the cervix, the parity of the patient and the adequacy of the pelvis. If the baby is sufficiently mature to survive so much the better but its fate is of secondary importance. However, the number of premature babies who will survive delivery will be greater by cesarean section than by other methods.

## THE PLACENTAL STAGE

The third stage of labor following delivery through the birth canal deserves special consideration. The abnormal location of the placenta may lead to incomplete separation and to continued bleeding from sinuses in the lower uterine segment or from trauma. There are too few muscle cells in the lower segment to produce normal contraction and retraction of the placental site, thereby interfering with placental separation. The same lack of musculature may prevent the normal closure of uterine sinuses. The proximity of the placental site to the vagina and sources of infection increases the hazard from this source.

The phase of placental separation can be expedited by the administration of ergonovine intravenously as the baby is being delivered. At least thirty seconds should elapse from the time the drug is injected until the baby is delivered in order that the ergonovine can exhibit its action. Usually the placenta separates promptly with the passage of the infant out of the uterus and it should be expressed. If separation is delayed in the presence of bleeding the placenta should be removed manually. Invasion of the uterus is not without risk but if carried out with proper regard to asepsis it is far less dangerous than continued blood loss. Continued bleeding after the placenta is out of the uterus calls for a careful exploration of the uterine cavity for a retained fragment of placenta as well as an examination of the lower uterine segment and vagina for trauma. Lacerations which bleed should be sutured. Bleeding from the placental site may have to be controlled by a uterine pack. Tamponade should begin in the corporeal cavity, extending into the lower uterine segment and include the vagina.

It will be noted in Table VII that manual removal of the placenta was indicated in 36 instances. Uterine tamponade to control continued bleeding was necessary in 15 patients. Neither method sufficed in 5 patients for they continued to bleed and hysterectomy had to be performed. This major procedure can be life-saving if the delay is not too great. The patient who continues to bleed in spite of a well placed uterine and vaginal pack and the patient in whom bleeding from trauma cannot

TABLE IX.—MORBIDITY IN PLACENTA PREVIA  
1931 TO 1945

Morbidity (22 x per cent)	Complete	Partial	Incomplete Marginal	Low lying	Total
Endometritis	12	2	7	4	25
Thrombophlebitis	3	4	10	2	19
Wound infection	3	0	2	0	5
Septopyemia	0	1	0	0	1
Cystopyelitis	2	2	2	1	7
Ligation of ureter	0	1	0	0	1
Upper respiratory	0	0	2	0	2
Cellulitis of breast	0	0	0	1	1
Transfusion reaction	1	0	4	0	5
Cause undetermined	1	0	5	0	6
Total	22	10	32	8	72
Mortality (0.6 per cent)					
Hemorrhage	1	0	0	0	
Thrombophlebitis and pulmonary infarction	0	0	1	0	1

be controlled by suture should have adequate replacement of blood and an immediate hysterectomy.

## SUPPORTIVE TREATMENT

The ready availability of blood and plasma has been the most important contributory factor in the great improvement in the prognosis of placenta previa. The ability to replace blood loss promptly has influenced our therapy of all obstetrical complications associated with hemorrhage. Every maternity must have available a source of blood for the time factor in the replacement of blood is of the utmost importance. Plasma will maintain the circulation for a short period but blood or red cells are necessary for the patient who has had an exsanguinating hemorrhage. In Table VIII it will be noted that 139 patients or 40.3 per cent of all patients with placenta previa received at least one transfusion and that 21 patients had two or more transfusions.

The hospital that has a blood bank is in an ideal position to provide ample amounts of blood readily. The smaller maternity should have facilities for the typing and matching of patients and donors at all times. A list of donors among the personnel, particularly those in blood group O should be posted in the

TABLE X.—FATE OF INFANTS IN PLACENTA PREVIA 1931 TO 1945

	Birth weight Grams	Total	Still-births	Live births	Died in hospital	Survival of live births
Complete	2500+	43	1	41	1	40
	1000-2500	38	5	33	14	19
	—1000	10	5	5	5	0
Incomplete Partial	2500+	24	1	23	1	22
	1000-2500	13	7	6	4	2
	—1000	7	0	1	1	0
Marginal	2500+	70	6	64	7	57
	1000-2500	43	6	37	11	26
	—1000	9	7	2	1	1
Low lying	2500+	44	0	44	1	43
	1000-2500	25	6	19	4	15
	—1000	3	1	2	2	0
Total		379	52	327	52	275
Per cent			15.8	84.2	15.8	64.4

delivery room. Rh negative blood or donors should be available for the Rh negative patient. Blood loss in placenta previa may necessitate more than one transfusion and it is more than possible that a patient may be sensitized by the transfusion of Rh positive blood. These smaller institutions should stock plasma which can be administered while blood is secured. The State Health Departments are making plans to supply blood and plasma to hospitals so that this need may be met. It was possible to build up a world wide organization to supply blood to our troops in time of war and it should be possible to use our experiences to extend this boon to our civilian population in times of peace.

Parenteral fluids are valuable in the treatment of hemorrhage but they should be administered in conjunction with blood and not in place of it. Ringer's or saline solution can be given subcutaneously in liberal amounts. The intravenous use of hypertonic glucose solutions should be restricted until blood is available. In an emergency 500 cubic centimeters of a 20 per cent glucose solution will raise the blood pressure and help to maintain the circulation temporarily but a secondary and a more serious drop in blood pressure may ensue unless blood is administered.

TABLE XI.—SUMMARY OF INFANTS IN PLACENTA PREVIA 1931 TO 1945

Weight in grams	Over 2500 grams	1000-2500 grams	Under 1000 grams	Total	
				No.	Per cent
No babies	131	119	39	279	
No still births	9	24	19	52	18.6
No live births	272	95	20	387	84.2
No died in hospital	10	33	9	52	
Survival of live births	162	62	1	225	
Per cent	94.2	65.3	10.0		81.1
Per cent of total births	89.5	52.2	3.4		64.4
Total deaths, Twins, Congenital anomalies (major) Autopsies	104, 4 pairs (3 premature)	24, 4.3 per cent	72, 73.5 per cent		

## PROGNOSIS

The prognosis for the mother in placenta previa has improved to such an extent that deaths from placenta previa should be almost preventable in an urban community. The mortality from this complication can be kept below 1 or 2 per cent by making use of all the knowledge that is available today and the facilities of the large maternities. The morbidity and mortality in this group of patients are listed in Table IX. The overall morbidity of 22 per cent can be improved by greater care in the management of this complication. These patients were treated over a period of more than 14 years and many changes have occurred in the therapy of some of the complications listed under morbidity.

The danger of infection and thrombophlebitis is emphasized in our statistics. Together they accounted for the morbidity in 57 of the 72 patients. Sulfa drugs and antibiotics have decreased the hazard of infection to some extent in the last few years but much remains to be accomplished along these lines. Twenty of our patients, including the fatal case, developed thrombophlebitis. Infection predisposes to thrombosis but the location of the placental site is the most important contributory factor. Measures to combat thrombosis have not been used extensively and are still on trial. Much more investigative and clinical observations are necessary to extend the use of the several anticoagulants to obstetrics.

The maternal mortality in this group of patients was 0.6 per cent. Résumés of the histories of the 2 patients who died follow:

M. H., No. 160045, aged 33 years, tripara, quintigravida, 1 abortion, was first examined when 20 weeks pregnant. History and physical findings were essentially normal. At 37 weeks there was painless bleeding and vaginal examination revealed marginal placenta previa. At 37½ weeks sudden profuse hemorrhage of 600 cubic centimeters occurred. Laparotomectomy with tubal ligation was carried out under local anesthesia. On the 3rd postoperative day her temperature was 38.8 degrees, and cough and râles in the left lower lobe were present. On the 9th postoperative day she had continued fever, pain and swelling in the left leg. On the 10th postoperative day there was present moderate purulent discharge from the wound. On the 14th day she had pain in the left chest and râles, temperature was 38.5 degrees and pulse 100. On the 16th day her condition was unchanged; however, at noon she developed sudden dyspnea, cyanosis, weak rapid pulse, cold clammy skin, but no evidence of acute pulmonary edema, and expired. Autopsy revealed bilateral massive acute pulmonary embolism and old infected pulmonary infarcts.

M. D., No. 65906, aged 37 years, tripara, quadrigravida, 1 stillbirth, anemia in 1937, was first examined when 18 weeks pregnant, at which time she had varices and monilia vaginitis. When 40 weeks pregnant she was admitted for study; hypertension: 170/120. At 41 weeks medical induction failed; bleeding was 75 cubic centimeters. Vaginal examination revealed total placenta previa. Laparotomectomy was carried out under local anesthesia; incision through placenta with marked bleeding, 600 cubic centimeters. Manual removal of placenta, tight packing. At time of skin closure, the blood pressure could not be obtained. Patient given caffeine, ephedrine, fluids, transfusion; 1000 cubic centimeters of blood expressed from uterus; second transfusion given. Respirations shallow, pulse weak, blood pressure 0. She expired 2 hours after operation. Autopsy showed exsanguination, atelectasis of both lower lobes, meconium in pulmonary vessels, fatty changes in liver.

Both of these deaths have been classified as preventable by our staff. The patient who died of hemorrhage bled profusely throughout the operation without anyone in attendance being aware of the gravity of her condition. More clinical experience on the part of the obstetrician would have prevented this fatality. The second patient was admitted to the hospital because of painless bleeding and a diagnosis of placenta previa was made on vaginal examination. The termination of the pregnancy was delayed 4 days when a sudden pro-

fuse hemorrhage of 600 cubic centimeters necessitated abdominal delivery. She developed a puerperal infection, pelvic thrombophlebitis and succumbed from a pulmonary infarct on the sixteenth day. It is possible that the termination of the pregnancy at the time the diagnosis of placenta previa was established would have decreased the hazard of infection and the subsequent thrombophlebitis. Delivery 3 or 4 days after a vaginal examination in a patient with placenta previa is a most inopportune time in regard to the hazard of infection.

The prognosis for the baby in placenta previa is serious as the statistics in Tables X and XI indicate. Of 329 babies who were born to the 325 mothers, 225 or 68.4 per cent were discharged from the hospital alive. The 104 babies who did not survive were equally divided between stillbirths and neonatal deaths.

The most important cause for the failure of the baby to survive was prematurity. Our policy of terminating the gestation promptly when the diagnosis of placenta previa is established must necessarily result in the sacrifice of many babies too young to survive an extrauterine existence. Only 1 baby of 29 weighing less than 1000 grams survived although 10 were delivered alive. In the group weighing 1000 to 2500 grams there were 119 babies of whom 95 were born alive but only 62 or 65.3 per cent of these survived. However, babies weighing more than 2500 grams fared much better for 172 of 181 were born alive and 162 or 94.2 per cent of these survived and were discharged from the hospital.

Up to the present time the previable and the premature baby have been considered expendable in order to insure the greatest possible safety for the mother. The dangers of hemorrhage, infection, and thrombophlebitis preclude the continuation of the pregnancy in the patient in whom placenta previa is diagnosed. It is possible that this viewpoint may change. The patient who remains in a hospital where blood can be administered readily may run little risk from serious blood loss. The prophylactic use of the newer antibiotics may decrease the hazard of infection. Cesarean section provides a safer method of delivery for the premature fetus than delivery through



the pelvis. However, we must never lose sight of the fact that once a cesarean is performed future deliveries must be by the abdominal route. All of these factors will have to receive their proper weight in any future decision to change our present management which has yielded such excellent results for our mothers.

#### CONCLUSIONS

Placenta previa is still a major cause of morbidity and mortality but modern management has robbed this condition of much of its terror. It has been possible to deliver 325 consecutive patients with placenta previa during the years 1931 to 1945 with a maternal mortality of 0.6 per cent.

The following procedure is followed at the Chicago Lying-in Hospital. All patients who have vaginal bleeding late in pregnancy are referred to the hospital for examination, diagnosis, and treatment. When suitable blood is available, a vaginal examination is carried out to determine the presence of placenta previa, its extent, the condition of the cervix, fetal position, the adequacy of the pelvis and the state of the soft parts. These factors plus the age, parity, and the physical condition of the patient will determine the choice of treatment for the control of bleeding and delivery. Some of the accepted methods of treatment made honorable by tradition have no place in the modern hospital.

# CAUSALGIA

## A Study of 75 Cases

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THE term "causalgia" was first used by Mitchell, Morehouse, and Keen in 1864 to designate a bizarre symptom complex occurring after injury to peripheral nerves. The main features of this symptom complex are severe burning pain and hyperesthesia, in association with trophic and vasomotor changes in the injured extremity. Little is known about the fundamental cause of this condition, and the theories advanced to explain it are so numerous that no attempt shall be made to develop them. Suffice it to say that in certain individuals following injury to one or more peripheral nerves a painful reflex mechanism is set in motion which is accompanied by abnormal vasomotor activity, manifested by varying degrees of vasodilatation or vasoconstriction. Relief can be obtained in most instances by surgical interruption of the appropriate sympathetic pathways.

In this paper we present the data from 75 patients who showed this symptom complex. Fifteen of these cases have previously been reported by one of us, with Captain Devine (3). These 75 cases were encountered in a series of 1,477 peripheral nerve injury cases admitted to the neurosurgical service of Percy Jones General Hospital from January 15, 1943, to May 31, 1945, an incidence of approximately 5 per cent. Three patients were officers and 72 enlisted men. The ages ranged from 19 to 39 years.

The peripheral nerve injury was incomplete in every instance and resulted from penetrating shell fragment or bullet wounds. The sciatic nerve was involved in 29 cases; the median in 16 cases; the brachial plexus (pre-

dominantly the lateral and medial cords) in 13 cases; the median and ulnar in 8 cases; the median, ulnar, and radial in 3 cases; the tibial and peroneal (below the knee) in 2 cases; the tibial in 2 cases; the median and radial in 1 case; and the femoral nerve in 1 case. The nerve injury was proximal to the elbow or knee in 66 cases (88 per cent) and distal in 9 cases (12 per cent). No patient had accompanying major vascular injuries.

In 44 of the 75 cases the burning pain developed immediately after the injury, in 14 within the first 48 hours, and in the rest (17) in from 72 hours to 2 months. The symptoms had been present for periods of time ranging from  $3\frac{1}{2}$  weeks to 15 months. The majority of patients were treated within 4 months from the time of injury.

### SYMPTOMS AND SIGNS

The cardinal symptom in each case was burning pain of a throbbing or aching character. The pain was always referred to the distal part of the involved extremity and was not confined to the autonomous zone of the injured nerve though it was usually more intense in that zone. In the hand it was referred chiefly to the palm and fingers; in the foot, to the instep, sole, and toes. The intensity varied from less severe states to the unbearable. The pain was continuous but subject to exacerbation by the slightest emotional or physical stimulus, and most of these patients appeared in a perpetual state of defense and went to absurd extremes to protect the painful limb. The severity of the pain rendered an accurate assessment of the nerve injury impossible in many cases.

The vasomotor manifestations were of two types, vasodilatation and vasoconstriction, and in no case was there noticeable alteration

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Read at the Surgical Conference of the Sixth Service Command, Chicago, Illinois, July 23, 1945.

TABLE—SUMMARY OF CASES\*

Case Age	Injury	Onset	Duration	Relief from moisture	Nerves involved	Treatment	Result
1 B I L 22	Bullet, left wrist	24 hours	7 mo.	Cold	Median	Sympathectomy, preganglionic, D 2-3	Relief
2 A M 20	Shell fragment, left leg	Immediate	4½ mo.	Cold	Tibial and peroneal	Sympathectomy, L 2-3	Relief
3 V V S. 22	Bullet, left buttock	2 weeks	5½ mo.	Cold	Sciatic	Sympathectomy, L 1-2-3	Relief
4 H W R. 36	Shell fragment, right thigh	Immediate	6 weeks	Cold	Sciatic	Sympathectomy, L 2-3	Relief
5 P K F 34	Shell fragment, left arm	4 days	5 mo	Cold	Median, ulnar and radial	Sympathectomy, preganglionic, D 2-3	Relief
6 E F A 24	Shell fragment, left buttock	Immediate	6 mo	Warm	Sciatic	Sympathectomy, L 1-2-3-4	Relief
7 T I D 26	Shell fragment, left buttock	Immediate	3 mo.	Warm	Sciatic	Sympathectomy, L 1-2-3-4, D 11-12	Relief
8 C M. 30	Shell fragment, right thigh	Immediate	6½ mo.	Warm	Sciatic	Sympathectomy, L 2-3	Relief
9 J S 28	Shell fragment, right thigh	Immediate	2½ mo	Warm	Sciatic	Sympathectomy, L 2-3-4	Relief
10 C D C 27	Bullet, left arm	Immediate	5 mo	Warm	Median	Sympathectomy, preganglionic, D 2-3	Relief
11 J B L 26	Shell fragment, left neck	24 hours	5¼ mo.	Warm	Brachial plexus	Sympathectomy, preganglionic, D 2-3	Relief
12 F J D. 27	Shell fragment, right arm	48 hours	7¼ hrs.	Warm	Median	Sympathectomy, preganglionic, D 2-3	Relief
13 E S 22	Shell fragment, right thigh	24 hours	5¼ mo	Warm	Sciatic	Sympathectomy, L 2-3	Relief
14 W C S. 23	Shell fragment, left forearm	Immediate	4¼ mo	Warm	Median and ulnar	Sympathectomy, preganglionic, D 2-3	Relief
15 J H M. 22	Shell fragment, left leg	Immediate	2 mo	Warm	Tibial	Sympathectomy, L 2-3	Relief
16 M E L. 31	Bullet, right arm	2 weeks	6 mo	Warm	Median	Sympathectomy, preganglionic, D 2-3	Relief
17 C M. 31	Shell fragment, right thigh	Immediate	3½ mo	Cold	Sciatic	Sympathectomy, L 2-3	Relief
18 C W P 23	Shell fragment, right buttock	Immediate	5 mo	Warm	Sciatic	Sympathectomy, L 1-2-3	Relief
19 J K S. 20	Shell fragment, right thigh	Immediate	4 mo	Warm	Sciatic	Sympathectomy, L 2-3	Relief
20 J C G. 22	Shell fragment, left leg	48 hours	1½ mo.	Cold	Tibial and peroneal	Sympathectomy, L 2-3	Relief
21 H A S. 31	Shell fragment, left axilla	6 weeks	3¼ mo	Warm	Brachial plexus	Sympathectomy, preganglionic, D 2-3	Relief

\*The first 15 of the 75 cases were summarized in a previous publication (3).

TABLE—SUMMARY OF CASES\*—Continued

Case Age	Injury	Onset	Duration	Relief from moisture	Nerves Involved	Treatment	Result
22 E.V.Z. 23	Shell fragment, left thigh	Immediate	4 mo.	Cold	Sciatic	Sympathectomy, L 2-3	Relief
25 B.J.W. 19	Shell fragment, right thigh	2 weeks	3½ mo.	Cold	Sciatic	Sympathectomy, L 2-3	Relief
24 L.M.S. 15	Shell fragment, right forearm	Immediate	2½ mo.	Warm	Median and ulnar	Sympathectomy, preganglionic, D 2-3	Relief
25 W.E.R. 19	Bullet, left axilla	2 weeks	4½ mo.	Cold	Brachial plexus	Sympathectomy, preganglionic, D 2-3	Relief
26 S.P.C. 35	Shell fragment, left forearm	Immediate	3½ weeks	Warm	Median	Sympathectomy, preganglionic, D 3-4 Later neurothaphy, median nerve	Relief
27 A.B.Z. 31	Bullet, left neck	Immediate	3 mo	Warm	Brachial plexus	Sympathectomy, preganglionic, D 3-4 Later neurolysis of 8 C. and 1 D. roots	Relief
28 R.L.V. 26	Bullet, right thigh	Immediate	1¼ mo.	Cold	Sciatic	Sympathectomy, L 2-3-4	Relief
29 U.G.U. 25	Shell fragment, left axilla	Immediate	15 mo.	Warm	Brachial plexus	Sympathectomy, preganglionic, D 2-3	Relief
30 M.A.H. 37	Bullet, right axilla	Immediate	4 mo	Cold	Brachial plexus	Sympathectomy, preganglionic, D 2-3	Relief
31 C.L.S. 16	Shell fragment, left arm	Immediate	2 mo	Cold	Median	Sympathectomy, preganglionic, D 2-3	Relief
32 R.C.W. 19	Shell fragment, left axilla	Immediate	3½ mo	Cold	Median and ulnar	Sympathectomy, preganglionic, D 2-3	Relief
33 D.E.S. 21	Shell fragment, left arm	48 hours	5 mo.	Cold	Median and ulnar	Sympathectomy, preganglionic, D 2-3	Relief
34 J.W.B. 20	Shell fragment, left thigh	Immediate	3½ mo.	Cold	Sciatic	Sympathectomy, L 2-3	Relief
35 T.C. 15	Bullet, left arm	48 hours	6½ mo	None	Median	Sympathectomy, preganglionic, D 2-3	Relief
36 E.D. 37	Shell fragment, right thigh	4 days	7 mo.	Warm	Sciatic	Sympathectomy, L 1-2-3	Relief
37 T.H.J. 21	Shell fragment, left arm	Immediate	8 mo	Warm	Median	Sympathectomy, preganglionic, D 2-3	Relief
38 P.C.N. 31	Shell fragment, right neck	48 hours	6 mo	Cold	Brachial plexus	Sympathectomy, preganglionic, D 2-3	Relief
39 M.A.C. 21	Bullet, right thigh	Immediate	7 mo.	Cold	Sciatic	Neurothaphy	Relief
40 L.E.N. 24	Bullet, left thigh	Immediate	3 mo.	Warm	Sciatic	Neurothaphy	Relief
41 E.E.V. 23	Bullet, left forearm	Immediate	5 mo	Warm	Median and radial	Sympathectomy, preganglionic, D 2-3	Relief
42 L.A.S. 25	Shell fragment, right axilla	Immediate	3½ mo	Warm	Brachial plexus	Sympathectomy, preganglionic, D 2-3	Relief

\*The first 25 of the 75 cases were summarized in a previous publication (3).

TABLE—SUMMARY OF CASES\*—Concluded

Case Age	Injury	Onset	Duration	Relief from moisture	Nerves involved	Treatment	Result
41. S.W. 30	Bullet, left arm	Immediate	2 mo	Warm	Median, radial and ulnar	Sympathectomy, preganglionic, D 2-3	Relief
44. D.A.L. 23	Shell fragment, right buttock	2 weeks	2½ mo.	Cold	Sciatic	Sympathectomy, L 1-2-3-4, D 11-12	Relief
45. F.A. 33	Shell fragment, right axilla	1 week	4 mo.	Cold	Brachial plexus	Sympathectomy, preganglionic, D 2-3	Relief
46. H.U.W. 23	Bullet, left axilla	Immediate	3 mo	Cold	Brachial plexus	Sympathectomy, preganglionic, D 2-3	Relief
47. C.E.H. 20	Bullet, right thigh	Immediate	4 mo	Cold	Femoral	Sympathectomy, L 1-2-3-4	Relief
48. L.P.S. 33	Shell fragment, right arm	Immediate	6½ mo	Cold	Median, ulnar and radial	Sympathectomy, preganglionic, D 2-3	Relief
49. F.M.C. 24	Shell fragment, left arm	Immediate	1½ mo.	None	Median and ulnar	Sympathectomy, preganglionic, D 2-3	Relief
50. S.J.L. 30	Shell fragment, right axilla	Immediate	3 mo	Warm	Median	Sympathectomy, preganglionic, D 2-3	Relief
51. I.C.R. 25	Shell fragment, left thigh	3 days	5 mo.	Cold	Sciatic	Sympathectomy, L 1-2-3	Relief
52. R.E.L. 25	Bullet, left thigh	4 days	5 weeks	Cold	Sciatic	Sympathectomy, L 1-2-3	Relief
53. A.S.F. 24	Shell fragment, left thigh	1 week	7 weeks	Cold	Sciatic	Sympathectomy, L 1-2-3	Relief
54. S.R.H. 20	Bullet, left axilla	Immediate	3 mo.	Cold	Brachial plexus	Sympathectomy, preganglionic, D 2-3	Relief
55. W.M.B. 30	Bullet, right thigh	2 mo	3½ mo.	None	Sciatic	Sympathectomy, L 1-2-3-4	Relief
56. V.H.K. 28	Shell fragment, right thigh	2 weeks	1¼ mo.	Warm	Sciatic	Sympathectomy, L 1-2-3	Relief
57. F.W.S. 19	Shell fragment, right axilla	16 hours	2½ mo.	Cold	Brachial plexus	Sympathectomy, preganglionic, D 2-3	Relief
58. W.P.C. 20	Shell fragment, left arm	Immediate	5¼ mo	Warm	Median and ulnar	Sympathectomy, preganglionic, D 2-3	Relief
59. D.S.S. 23	Bullet, left axilla	24 hours	2½ mo.	None	Median and ulnar	Sympathectomy, preganglionic, D 2-3	Relief
60. F.I.S. 21	Shell fragment, right leg	48 hours	1 mo	Cold	Tibial	Sympathectomy, L 2-3-4	Relief

\*The first 15 of the 75 cases were summarized in a previous publication (3).

in the type while the patient was under our observation. The skin of those in vasodilatation was usually reddish, dry, scaly, and warmer than that of the normal extremity and the hair long and coarse. The skin of those in vasoconstriction was usually cold,

thin, and glistening, and sweated profusely. In this group there was usually loss of hair, tapering of the digits, and trophic changes in the nails.

Sixty-eight of the 75 patients obtained some relief from the application of moisture. Thir-

ty-eight preferred cold water; 30, warm water; and 7 noted no significant effect of moisture. It seemed that warm water gave relief where there was vasoconstriction and cold where there was vasodilatation.

Most of these extremities showed gradations of joint stiffness brought on by painful splinting and disuse. This was one of the greatest residuals after the relief of pain but proved amenable to physical therapy if treated early.

In the more severe cases, the patients were usually malnourished because of low food-intake.

Most of these patients were irritable, shut-in, critical of attendants, and showed no interest in family or friends even though they had been overseas for many months. Their facial expression manifested evidence of anxiety, weariness, and distress. These findings suggested that the disorder might be functional, so psychiatric examinations were carried out in some of our patients before and after operation. After relief of the pain, all appeared essentially stable and normal, and without exception they became pleasant, co-operative, and happy. In our patients there was no evidence of any definite predisposing constitutional factor responsible for the development of this syndrome.

There appeared to be no correlation between the severity of the nerve injury and the intensity of symptoms. The nerve lesion was incomplete in each case.

#### METHODS OF STUDY

These patients were studied to correlate subjective symptoms and trophic disturbances with blood flow in the injured part. Blood flow was determined by means of oscillometric and skin temperature readings in the first 15 cases and by skin temperature readings alone in the rest. Those in vasodilatation usually showed skin temperature readings from 1 to 4 degrees higher than readings of corresponding areas of the normal extremity; those in vasoconstriction showed readings from 2 to 6 degrees lower.

One patient in vasoconstriction developed malaria (*Plasmodium vivax*) and during the periods of elevation of temperature was com-

pletely free of pain. The pain returned, however, when the malaria was controlled. Because of this observation, artificial fever therapy was tried in 5 patients, 1 of whom remained well after 3 treatments. The others received as many as 5 treatments, with relief for the period of elevated temperature only. Subsequent sympathectomy was followed by relief in these 4 patients.

X-ray film of the painful part was made in 20 cases. Each showed some degree of demineralization of the small bones of the hand or foot as contrasted to the normal. The changes were most marked in those in vasodilatation. However, the demineralization appeared no more pronounced than in some cases of comparable nerve injuries without causalgia.

#### TREATMENT

Seventy-two of our patients were treated by surgical procedures, 70 by surgical interruption of the sympathetic chain, which included preganglionic ramisectomy of the second and third dorsal ganglia for the upper extremity and removal of the second and third lumbar ganglia for the lower extremity. Sixty-three of the 70 were cured by the initial operation.

Two patients with severe but incomplete lesions of the sciatic nerve were treated by resection of the injured segment and neurorrhaphy. This procedure relieved the pain in both instances.

In every case, procaine block of the appropriate sympathetic ganglia was done before definitive treatment was carried out. This procedure invariably gave immediate and dramatic relief of the pain for periods ranging from 1 to 3 hours, but in most patients it reached its previous intensity in a very short time. In a few, partial relief persisted for several days. During the period of remission, the patient became co-operative and permitted a more thorough sensory and motor evaluation of the involved extremity, whereas examination was unreliable before the pain was relieved. Frequently, where no motor function had been observed previously, the patient began to move the extremity immediately. This suggested that in some of the

cases the pain had initiated a reflex paralysis (Livingston).

Since numerous reports have been made of permanent cures from one or more sympathetic blocks, some patients were injected 4 to 8 times. There was always immediate relief of the pain, but no patient obtained complete and permanent relief from this procedure. However, the sympathetic block served two useful purposes: First, by relieving the pain temporarily it permitted a more accurate evaluation of the nerve injury; and second, it established the indication for sympathectomy. In the last 55 cases, this procedure was used for diagnosis only.

Neurolysis was done in 5 cases and periarterial sympathectomy at the level of the injury in 3 cases, but the pain was not influenced by these procedures. Later these patients were sympathectomized with relief.

#### SPECIAL CASES

Seven patients were not completely cured by the initial operation on the sympathetic chain but 4 were cured by subsequent operations. These deserve special comment.

Three patients with high sciatic injuries (buttock or above) obtained partial relief after removal of the second, third, and fourth lumbar ganglia. Later removal of the first lumbar ganglion resulted in complete relief.

Another patient with a similar lesion had the first, second, third, and fourth lumbar ganglia removed initially. Following this he was completely relieved of pain for 72 hours, when moderate pain recurred. Paravertebral procaine blocks at the level of the eleventh and twelfth dorsal vertebrae gave immediate and complete though temporary relief on two occasions. A starch-iodine test demonstrated sweating over the buttock, leg, and dorsum of the foot. It was concluded that some sympathetic fibers to the injured segment of nerve remained. The eleventh and twelfth dorsal ganglia were removed by resecting the twelfth rib. At this operation the diaphragm was sectioned to verify that the upper lumbar chain had been removed. Complete relief followed.

A similar patient with a sciatic lesion at the buttock had the second, third, and fourth

lumbar ganglia removed, followed by incomplete relief. Procaine block at the level of the first lumbar vertebra gave temporary relief. The first lumbar ganglion was then removed without benefit. Procaine injection at the eleventh and twelfth dorsal vertebrae gave complete relief on two occasions. With this evidence plus the fact that sweating persisted in the location of the pain and also at the level of the injury, the eleventh and twelfth dorsal ganglia were removed and complete relief followed.

Two patients with lesions of the upper extremity had the third and fourth dorsal ganglia interrupted instead of the second and third because of mistaking the fourth rib for the third in the exposure. This produced only partial interruption of the sympathetic supply to the involved limb and these patients were only partially relieved. The first patient was then relieved by a neurorrhaphy of the median nerve. In the second case neurolysis of the eighth cervical and first dorsal roots did not affect his symptoms. However, he has since improved to the point where no further surgical interference seems indicated.

#### DISCUSSION

In each case of this series, symptoms resulted from high velocity missile wounds of large mixed peripheral nerves and we feel that they represent true causalgia. For a time it was felt that causalgia was a distinct entity, but the underlying disorder is no doubt related to that of a heterogeneous group of painful posttraumatic dystrophies, including Sudeck's atrophy, posttraumatic painful osteoporosis, and other so-called minor causalgias (Homans). The chief difference is one of degree, perhaps, varying with the size of the nerve involved.

The vasomotor disturbance was of two types, vasodilatation and vasoconstriction. Forty patients of this group were in vasodilatation and 35 in vasoconstriction. The subjective symptoms were identical but the objective signs varied, yet interruption of the sympathetic chain relieved the pain in both groups. Therefore, it would appear that alteration of blood flow was not responsible for the pain.

In the majority of our cases the intense burning pain occurred immediately after the injury, which rules out infection and irritative scar formation as significant etiologic factors. In fact, with rare exception the traumatic wounds healed without gross infection.

The trophic manifestations in some cases were essentially the same as those seen in comparable nerve injuries without causalgia, but the secondary joint changes with resulting fibrous ankylosis were more severe because of voluntary immobilization of the painful extremity.

Seven patients of this group failed to obtain complete relief from the initial operation upon the sympathetic chain. Five were patients with wounds involving the sciatic nerve at the buttock or above. Removal of the second and third lumbar ganglia had been effected in each case. Subsequent removal of the first lumbar ganglion in 3 of these resulted in complete cure. In 2, removal of the eleventh and twelfth dorsal and first lumbar ganglia were required. In the other 2 cases which involved the upper extremity, incomplete sympathectomy was done at the initial procedure when the fourth rib was removed instead of the third. One patient was then relieved by neurorrhaphy of the median nerve. In the other case, neurolysis of the eighth cervical and first dorsal roots did not affect his symptoms. However, he has since improved to the point where no further surgical interference seems indicated.

Those patients not relieved by the initial sympathectomy showed evidence of incomplete sympathetic denervation, not only to the area of referred pain, but to the area of injury. This was verified by sweating in these areas as shown by starch-iodine tests and evidence of lowered skin resistance to electrical conduction. This has been more noticeable in the cases involving the lower extremity where the injury was high in the thigh.

From these observations, it would appear that the sympathectomy must include the injured segment of nerve. However, the possibility of anomalies of the sympathetic chain must be considered. It can be stated that removal of the second, third, and fourth lumbar ganglia may be inadequate for lesions high in

the thigh. In these cases it may be necessary to remove the first lumbar as well as the eleventh and twelfth dorsal ganglia. For lesions of the upper extremity preganglionic sympathectomy of the second and third dorsal ganglia is necessary. The segment of the sympathetic chain removed has been identified postoperatively by x-ray examination through the use of a metallic clip on the proximal end of the chain when the lumbar operation was done and identity of the rib removed when the dorsal operation was done.

Various medical and surgical treatments have been advocated for the cure of causalgia but in our experience surgical interruption of the appropriate sympathetic ganglia has been the most effective procedure. It has provided relief in each case and has the advantage of carrying a minimal penalty, in contrast to more radical surgical procedures such as regional injection of alcohol, rhizotomy, and chordotomy.

#### SUMMARY AND CONCLUSIONS

The data from 75 cases of causalgia due to war wounds of large mixed peripheral nerves have been presented and the following conclusions are drawn.

1. The pathologic mechanism is obscure.
2. The disorder is characterized by burning pain in association with vasomotor disturbances in the distal part of the extremity.
3. The vasomotor disturbances are of two types, vasoconstriction or vasodilatation. The possibility that the vasomotor state may vary in any case is recognized but has not been observed.
4. The pain can be relieved by appropriate sympathectomy. The sympathectomy must be complete, however, and with lesions involving the upper portion of the sciatic nerve removal of the sympathetic chain as high as the eleventh dorsal ganglion may be required. For lesions of the upper extremity preganglionic operation is adequate.
5. Procaine block of the appropriate chain is a necessary diagnostic procedure.
6. Repeated procaine block as a therapeutic agent has not been effective in our hands. Certain patients have improved with this procedure, but none has been completely relieved.



7. Resection of the injured segment of nerve will provide relief. Neurolysis and periarterial sympathectomy at the level of the injury are ineffective.

8. Sympathectomy should be done as soon as the diagnosis is established, to prevent the psychic trauma of prolonged pain and crippling joint stiffness.

9. Causalgia has been noted only with incomplete nerve lesions.

10. Recovery of function is often rapid after relief of pain. Consequently, primary neurorrhaphy is rarely indicated.

NOTE.—Our series of causalgia cases treated by sympathectomy now totals 105 cases as of December 31, 1945, including 2 additional cases of high sciatic injury requiring removal of the 11th and 12th dorsal ganglia, and the results and conclusions remain the same. For the same period 2,318 cases of peripheral nerve injuries were admitted.

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# TREATMENT OF PAINFUL SPONDYLOLISTHESIS

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SINCE the introduction of surgical procedures for the treatment of painful spondylolisthesis, one of the most frequent problems that the orthopedic surgeon has to face is to decide whether a specific case has to be treated conservatively or requires a spinal fusion. On the other hand, when this decision has been reached, and a spinal fusion is indicated, the next problem is in regard to the type of operative technique that will prove most satisfactory.

Some French surgeons oppose the use of the Albee technique on the basis that the graft is situated too far posteriorly (Guilleminet); that in the event of an associated spina bifida, it is impossible to obtain a solid insertion of the osseous transplant (Salmon and Contiades); or that when the superior spinal segment is markedly displaced, it is difficult to obtain good contact between the graft and the spinous processes (Mathieu and Demirleau). The technique preferred by most of these authors is the use of two flexible osteoperiosteal grafts placed on either side of the spinous processes. Desfosses and Colleu have advised the use of small grafts inserted between the superior and inferior articular processes, in order to obtain a bridging of the abnormal gap in the neural arch.

Because all these previously described techniques have no direct action upon the anterior part of the vertebra—where the real displacement takes place—several other procedures have been introduced directed toward producing a fusion between the vertebral bodies or the transverse processes of the fifth lumbar vertebra and the iliac bones, by means of an osseous transplant (Lance and Aurousseau, Friberg, Mathieu and Demirleau, Zahradnick). Others, following Capener's suggestion have been fusing the fifth lumbar body to the sacrum by means of a tibial graft placed through a transabdominal route (Burns, Jenkins, Kellogg Speed, Mercer, Friberg). Finally,

Dandy emphasizes the importance of the intervertebral disc pathology in cases of spondylolisthesis and advises the curettement of the defective disc or discs, and the fusion of the anterior spine.

In this clinic the surgical treatment of painful spondylolisthesis consisted of the use of the Hibbs' technique or a combination of those of Albee and Hibbs as described by Steindler. Technically both procedures have been safe and easily accomplished. However, they are not indicated unless there is assurance that the results obtained will be superior to results obtained by conservative treatment and that the procedures will prevent further slipping of the displaced vertebral bodies.

The purpose of this report is the review of the end-results of cases having a long term follow-up. The material available consisted of 313 cases of spondylolisthesis. For this analysis we selected those cases having good clinical and radiographic follow-up for at least 2 years after initiation of treatment. Cases with other extraspinal conditions that could mask the evaluation of the end-results (osteoarthritis of the hips, old fractures of femur or tibia, poliomyelitis of lowers) were also excluded.

There were 60 cases that fulfilled all these requirements. These patients were treated either conservatively or surgically or by a sequence of both. There were 45 males and 15 females. The age of the patients ranged from 12 to 55 years.

## RESPONSE TO TREATMENT

*Conservative measures.* Thirty-four patients were treated by physiotherapy, traction, and spinal support. The results were as follows:

Complete relief, characterized by complete freedom from pain and ability to resume former occupation, was obtained in 14 cases (41.1%). In 1 of these cases back pain recurred after a symptom-free period of 10 years.

Partial relief, characterized by back pain only after exertion, was obtained in 12 cases (35.2%).

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No relief in 8 cases (23.5%).

*Spinal fusion.* These cases are divided in 2 categories:

1. Patients treated by fusion without previous trial of conservative treatment. In 26 cases spinal fusion was performed within a few weeks after the patient was admitted, or as soon as the acute episode of back pain had been relieved by physiotherapy and traction. The results were as follows: Complete relief, characterized by freedom from pain and ability not only to resume their former occupations but also their habitual sports, was obtained in 20 cases (76.9%). The observation period of these cases ranged from 2 to 8 years after operation was performed (average observation period was 3.5 years). Partial relief, characterized by some back pain after exertion, in 5 cases (19.2%). No relief in 1 case (3.8%).

2. Patients treated by fusion after trial with conservative treatment. In 13 cases of spondylolisthesis in which the conservative treatment had produced only partial relief or no relief at all, spinal fusion was ultimately performed. The results were as follows: Complete relief of symptoms was obtained in 7 cases (53.8%). These patients had been subjected to conservative treatment before the operation for periods of time ranging from 4 months to 5 years. The follow-up after spinal fusion was from 2 to 11 years (average observation period was 4.5 years). Partial relief of symptoms was obtained in 1 case (7.6%), the patient complaining of some back pain after exertion. Before operation this patient had continuous low back pain with sciatic radiation. No relief of symptoms was obtained in 5 cases (38.4%). These 5 patients were treated conservatively for periods ranging from 6 months to 1½ years, prior to surgery, with no improvement.

#### COMPARATIVE STATISTICS

If now we consider the results of the total 39 spinal fusions performed and compare with the 34 patients treated conservatively, we will observe that the percentage of good results was superior in the fused cases (69.2%) than in the ones treated by conservative measures (41.1%).

Also in favor of the surgical fusion, we must consider the fact that a certain number of the patients completely symptom free after the fusion of the posterior spine, had failed to respond adequately to conservative treatment.

#### THE PRESENCE OF SCIATIC RADIATION IN CASES OF SPONDYLOLISTHESIS

In 4 of the patients who failed to improve after surgical treatment, there was low back pain with associated sciatic radiation as far down as the ankle or toes. Since in recent years the rôle of the intervertebral disc as cause of low back pain has been greatly emphasized, these cases were rechecked for the possibility of overlooked disc pathology associated with the vertebral displacement.

The fact that these patients continued to complain of sciatic radiation after fusion was strongly in favor of this supposition. But it will be erroneous to form hasty conclusions based only on these 4 cases and state that the presence of a definite and persistent sciatic radiation before treatment constitutes a sign that all the symptoms will persist unless removal or curettage of the disc is performed.

Review of the histories of all the 60 patients here reported revealed the following:

Low back pain with sciatic radiation as far down as the ankle or toes was a complaint of 18 patients before initiation of treatment. In 10 of these cases, the radiation was unilateral; in the remaining 8, bilateral. In addition to the radiation, 3 patients complained of numbness and paresthesia in the lower extremities. The neurological examination was negative in all but 2, those being cases with unilateral radiation and having bilateral abolished Achilles reflex.

In none of them was the disc explored or curetted. They were treated either conservatively or by fusion of the posterior spine. Under treatment, complete relief of back pain and sciatic radiation was obtained in 10 cases (55.2%); complete relief of the sciatic radiation but some persistence of the back pain was obtained in 4 cases (22.2%); no relief was obtained in 4 cases (22.2%), which had previously been referred to as failures.

In view of these results, we have to accept either Steindler's proposal that there are other

conditions besides a herniated intervertebral disc that may produce sciatic radiation, or the fact that the symptoms produced by a defective disc when spondylolisthesis is present can be relieved in some cases by procedures other than the removal and curettage of the disc.

From a clinical point of view the most important point is the recognition of which patients will show improvement following fusion and which will remain unchanged after the surgical procedure has been performed.

Carefully checking the records of these 18 patients we were unable to find a definite sign. In all of them the neurological examination was inconclusive or negative; the leg signs were positive in both groups; so was the muscular spasm or the presence of sciatic scoliosis. However, there was one factor which appeared consistent and reliable. All patients who failed to respond to surgical fusion of the posterior spine were those who, under previous conservative treatment, had failed to show any degree of improvement. Consequently, it is advisable to treat these cases of spondylolisthesis with sciatic radiation conservatively for a period of time, and to perform an exploration of the intervertebral disc of those failing to respond, prior to fusing the posterior spine.

#### DEGENERATIVE CHANGES OF THE INTERVERTEBRAL DISC IN CASES OF SPONDYLOLISTHESIS

Degenerative changes in the intervertebral disc have been described by several authors. Schmorl and Junghanns found it deformed, thinner, sometimes S-shaped. Putschar observed the complete interruption of the annulus fibrosus and ossification of the anterior part. Hitchcock states that the buttress that develops on the anterior part of the sacrum in cases of spondylolisthesis is formed in large measure by the dislocation of the intervertebral disc itself.

As a result of this disc degeneration, instability and abnormal mobility at the level of the displaced vertebra are present. Roentgenographically, this is evidenced by the presence of sclerosis and reactive new bone formation.

In order to correct this instability, some surgeons have proposed fusing the anterior spine

at the level of the vertebral bodies. Dandy not only advises it, but states that fusion of the posterior spine without removing the discs accomplishes nothing because it merely covers the defective discs and the symptoms continue practically unchanged. Furthermore, he states that after the curettage of the disc the posterior graft will be contraindicated because it prolongs the period of recumbency and adds nothing to the fusion that follows complete removal of the disc.

We have no personal experience on this point but it seems to us that if all the symptoms described by the patient with spondylolisthesis could be relieved by fusing only the vertebral bodies, then one could conclude that in those cases in which spontaneous fusion between the fifth lumbar and the sacrum occurred, there should be freedom from all complaints. However, actual clinical experience does not substantiate this theoretical supposition. Among our material we found 3 cases in which there was an osseous fusion between the fifth lumbar body and the sacrum (Fig. 1), and 2 cases in which the osteophytic formation had been so marked that a solid osseous bridge extended all along the anterior part of the lumbosacral joint. Four of these patients were admitted complaining of recurrent episodes of low back pain of several years' duration. They were completely relieved either by spinal support or after a posterior spinal fusion had been performed.

These apparently contradictory findings cease to appear so paradoxical when, from the narrow field of the intervertebral disc, we turn to consider the vertebral column in its totality. It is then that we realize that in addition to the alterations produced by the defective disc upon the surrounding ligaments and nervous structures, the forward displacement of the whole upper spinal segment will also disturb the physiological harmony of the different structures responsible for the spinal stability and human posture. As a result, an extra burden is placed upon the spinal muscles and the spinal ligaments.

It is our impression that, while in cases of pure intervertebral disc disease or in very mild cases of spondylolisthesis the fusion of the anterior spine may be capable of produc-

ing a permanent relief, in those cases in which a marked forward displacement has already taken place, the posterior spine should be fused in order to provide a better stability for the back.

#### ROENTGENOGRAPHIC ASPECTS IN SPONDYLOLISTHESIS

The roentgenographic aspects of spondylolisthesis have already been described in detail by several authors (Schmorl and Junghanns, Capener, Brailsford) and consequently a general description is unnecessary. However, we are interested to study this condition through roentgenographic series of several years' duration, in order to determine the sequence of the pathological signs and to determine if there is any progression of the displacement after the conservative or surgical treatment had been undertaken.

One hundred and fifty-one cases were studied in detail. They were divided as follows:

*Spondylolisthesis affecting the fifth lumbar vertebra.* In 137 cases the displacement occurred at the fifth lumbar vertebra. Of these, 102 belonged to grade 1; 16 to grade 2; 10 to grade 3; 4 to grade 4, of Meyerding's classification. In addition, in 3 cases the displaced vertebra was inside the pelvis, in front of the first or second sacral segment.

Among the cases belonging to grade 1 of Meyerding's classification, the roentgenograms were not uniform. In 56 cases, the intervertebral disc was apparently normal. In 12 there was a thinning of the posterior part of the disc. In 34 the disc was markedly or totally destroyed. Sclerosis of the osseous surfaces could be observed in most of the cases with disc degeneration. In others, a buttress formation was present at the anterior part of the sacrum.

Among the cases belonging to grade 2 of Meyerding's classification, signs of localized osteoarthritis were present and practically all of them presented thinning of the intervertebral disc to variable degrees.

The cases belonging to grades 3 and 4 of Meyerding's classification could be subdivided in two groups, according to whether or not signs of new bone formation were present. When new bone formation took place, a buttress

at the anterior part of the sacrum was present in most of the cases, while in others the sacrum and the body of the fifth lumbar were fused together.

On the other hand when new bone formation did not take place, we observed the rounding off of the anterior border of the sacrum and, occasionally, the notching of the inferior surface of the fifth lumbar vertebra, forming what roentgenographically appeared to be a joint-like image between the last lumbar vertebra and the sacrum. The more advanced cases presented a tilting of the fifth lumbar body, a narrowing of the intervertebral foramen between the fourth and fifth lumbar vertebrae, and a flattening of the posterior third of the body of the last presacral segment (Fig. 2). Sclerosis of both osseous surfaces could be observed.

One of the most interesting phenomena was the flattening and redressement of the sacral body. In cases belonging to grades 1 and 2 of Meyerding's classification, the sacrum had a configuration and position compatible with anatomical individual variations. However, in some of the cases belonging to grade 3 and practically all those belonging to grade 4 of Meyerding's classification, on lateral projection the sacrum appeared to have a rounded off anterior border, the conformation was straight, and its position was more vertical than usual (Figs. 3 and 4).

*Spondylolisthesis affecting the fourth lumbar vertebra.* In 7 cases there was a forward displacement of the fourth lumbar vertebra. All presented a separate neural arch. The displacement was never very marked, corresponding to grades 1 or 2 of Meyerding's classification. In addition there was thinning of the intervertebral disc in 5 cases, localized osteoarthritis in 1 case, and sacralization of the fifth lumbar in 2 cases (Fig. 5).

*Pseudospondylolisthesis of Junghanns.* According to Sisefsky the term pseudospondylolisthesis was first used by Neugebauer for the cases of violent vertebral dislocation secondary to luxation fracture. More recently, Junghanns has used the same term to designate the dislocation of one vertebra upon another when there is not a preceding intense trauma or a separate neural arch. In addition, he observed





Fig. 5. Forward displacement of the fourth lumbar body. The fifth lumbar vertebra is sacralized.

More recently Stewart in a collection of Eskimo and Indian skeletons found 3 specimens similar to those described by Junghanns and could observe the existence of marked arthritic erosion of the articular facets of the small intervertebral articulations.

Among our patients we found only 1 case that presented all the characteristics described by Junghanns. The displacement occurred at the level of the fourth lumbar vertebra, and marked osteoarthritic changes of the opposing surfaces of the vertebral bodies were present. No signs of separate neural arch could be detected by lateral, right and left oblique projections. The corresponding intervertebral disc presented definite narrowing.

*Reverse spondylolisthesis.* The posterior displacement of a vertebral body has been observed by several authors and has received a wide variety of names. Sicard used the term retrospondylolisthesis; Lippens called it hierolisthesis; Mouchet spoke of sacrolisthesis; and finally the American authors (Ferguson, Smith, Johnson) have reported cases under the title of "posterior displacement of the fifth lumbar vertebra."

In spite of so many reports, the existence of such a condition has been denied by Willis, on the basis that we are dealing with an optical illusion. This author studied 50 skeletons of

the Haman Museum and found that in only 17 were the opposing surfaces of the fifth lumbar and the sacrum equal. Among the remaining ones, the anteroposterior diameter of the sacrum was from  $\frac{1}{4}$  to 1 inch shorter than that of the opposing surface of the last lumbar vertebra. In addition, in some cases the posterior border of the sacral surface was concave toward the neural canal.

Among our cases studied, we found this condition in 5 cases. The displacement was minimal and affected the fifth lumbar vertebra in all cases. The anterior borders of the fifth lumbar and the sacrum were in alignment. The condition remained stationary.

As there was not a separate neural arch in any of our cases we prefer to use the term "posterior displacement of the fifth lumbar vertebra." In order to avoid confusion it will be advisable to use the term spondylolisthesis only in those cases in which the vertebral displacement is secondary to a separate neural arch.

*Scoliosis associated with spondylolisthesis.* In 5 cases of spondylolisthesis a lumbar scoliosis was present. The curve extended up to the first lumbar or twelfth dorsal vertebra. There were 1 male and 4 females. The ages ranged from 13 to 16 years when first seen in the clinic. The cases were observed from 2 to 5 years.

While this small number of cases does not allow generalizations, we may state that we observed two main types. On one hand, we had cases in which the rotation of the vertebral bodies was the main characteristic. In these cases the rotation was present several months before the lateral curvature appeared. Under treatment, the lateral deviation could be easily corrected by means of a plaster cast, but the rotation remained unchanged. On the other hand, there was another group of cases in which the lateral deviation was the outstanding phenomenon. When the patients were recumbent, the spine appeared reontogenographically essentially normal. In the standing position, the vertebral bodies presented a minimal amount of rotation. Two of the patients belonging to this group were able at will completely to straighten their spinal curvature.

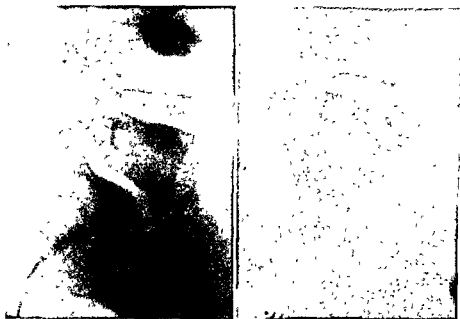


Fig. 6. a and b, The only change that occurred between August 8, 1938, a, left, and December 14, 1944, b, was a thinning of the posterior part of the intervertebral disc. Fusion was carried out in December, 1939.

After spinal fusion, a straight but rotated spine was obtained in the cases belonging to the first group. A normal and painless spine was the end-result in the second group of cases provided that the spinal fusion had been performed during the early periods of the curvature.

*The progression of the deformity.* In cases of spondylolisthesis affecting the fifth lumbar body, it previously was a widely accepted fact that, except for cases in which a buttress or osseous synostosis was present, the forward slipping could progress at any time, thus increasing the deformity. This concept had been substantiated by reports of several authors who had followed the progressive slipping by serial roentgenograms.

Friberg in 1939 aroused the doubt that progression of the forward slipping was a constant or even frequent phenomenon after puberty. By repeated measurements of the roentgenograms of 142 patients treated conservatively, he was able to find a change in the position of the affected vertebra in only 10 cases. Seven of these patients were under 20 years of age. In all of them the displacement was minimal and could be explained on the basis of a degeneration of the intervertebral disc.

After completion of his study, Friberg concluded that if there was any slipping at all

during adult life, it never was to such a degree that would justify the use of dangerous operative procedures. He further stated that in the literature published after 1925 there was not a single convincing picture showing a spontaneous change in the affected vertebral body.

It should be remembered that Ferguson in 1934 had already stated that although a gradual slipping of the displaced vertebra without trauma could be possible, he had never observed a case. He stated also that the displacement did not have much, if any, tendency to increase.

Going over the literature of the past 10 years, we have found several descriptions of cases of progressive slipping reported by Brailsford, Watson-Jones, Ferguson, Burckhardt, Hitchcock. But at any rate the number was comparatively small.

In our material studied we had the opportunity to observe 35 patients for periods ranging from 2 to 7 years. After repeated x-ray films taken approximately every 3 to 6 months, we were unable to find progression of the displacement in any of them. Eleven of these patients had been treated conservatively; 24 of them had been treated by primary fusion or fusion was done after trials of conservative treatment (Fig. 6 a and b).



## COMMENT

As spondylolisthesis is not a progressive condition after puberty in the majority of cases, the question arises as to when the displacement occurs.

It is an accepted fact that a marked forward displacement of the body of a vertebra, in the absence of trauma or pathological condition, is only possible because there is a separation at that part of the neural arch that Chandler called the "isthmus." The cause for the appearance of such a gap between the upper and lower articular apophysis of a vertebra has several theoretical explanations. One of the most widely accepted attributes the neural arch defect to a lack of fusion between two centers of ossification present in each half of a neural arch (Rambaud and Renault, Neugebauer). As more recent embryological studies have been unable to prove the existence of these two separate centers of ossification, and the percentage of spondylolysis found in human fetus is far lower than the percentage of separate neural arches observed in adult spines, this congenital theory has been less and less accepted. Other explanations, such as trauma at birth and after (Hitchcock, Azema, Glorieux and Roederer) progressive erosion of the isthmus, localized aseptic necrosis (Julitz), have been formulated by several authors.

Regardless of which of these theories we accept, the fact still remains that while spondylolysis may occur at any level of the spine, a marked forward displacement has only been observed at the fifth lumbar vertebra. This, together with the fact that while spondylolisthesis has been described in several human races it has never been found in the fetus or in the anthropoids (Willis), has called the attention of the anatomists and orthopedic surgeons to the peculiarities of the lumbosacral angle and to the characteristics of human posture.

The evolution of man's posture has been the object of several theoretical suppositions. Disregarding the more or less accepted explanations formulated by Keith, Morton and Wood Jones, we have fairly good evidence that man's posture, as an erect terrestrial biped, has suffered several modifications. Boule, in his book *Les*

*hommes fossiles*, states that the Neanderth man found in "La Chapelle aux Saints" had a crouching posture, a minimal lordosis, and lower limbs were in slight flexion. On the other hand, Mitchell quotes the studies of Professor Low, who, measuring the skeletons belonging to the Bronze age, found that the posterior vertical measurement of the lumbar vertebra slightly exceeded the anterior one. Professor Turner reports on his studies on human skeletons during the "Challenger" expedition as widely known. He found that the lumbar spine of one of the most primitive forms of the human race, the Andaman Islanders, was almost straight or slightly convex backward. Finally, Cunningham, studying the skeletons of several human races from the collection in the British Museum and the Museum of the Royal College of Surgeons in England, found that there was a progressive diminution of the vertical diameter and an increase of the sagittal diameters in Europeans and natives of India as compared with more primitive races such as the Andamans, Australians and Negroes. This is interpreted as a structural modification secondary to adoption of a better posture, because the more erect a man is, the more weight a vertebral body has to carry.

Therefore, we see that the configuration of the human spine has progressively changed, thus permitting more upright posture. However, the human spine has not only changed in configuration during the course of time. During the life span of an individual the vertebral column suffers also several alterations. These different changes have been described in detail by Bardeen, Willis, Carey, Mitchell and can be summarized as follows:

In an embryo of 7 millimeters the spinal column forms a single curve of forward convexity, the ventral surface of the sacrum facing the mid-thoracic region. From that moment on, there is a progressive uncoiling of the curvature. In an embryo of 50 millimeters the ventral surface of the sacrum faces approximately straight forward.

At birth, the lumbar spine is almost straight and the lumbosacral angle is minimal. Neither the vertebral bodies nor the discs are wedge-shaped.

When the child's hips start to extend, the lumbar vertebrae are pulled forward by the ligamentous structures and the psoas muscles, thus giving origin to the lumbar incurvation. This curve is fairly noticeable around the 9th to 12th postnatal month, when the child begins to stand and walk.

At the end of the second postnatal year a definite wedging of the lumbar vertebrae can be observed. Progressively, the sacral concavity becomes more and more marked and the lumbosacral angle more accentuated. The vertebral wedging increases until the subject reaches adult life.

In short, we may conclude that here we also observe the same phenomenon that took place during the course of ages: the apparition of a lumbosacral angle and of a lumbar lordosis in a previously straight or forward curved lumbosacral spine. The only difference is, that in an individual this process occurs from the time he is a 50 millimeter embryo up to puberty. If during this period a bilateral separate neural arch is present, the possibilities of a forward displacement should be very great. Especially at the level of the fifth lumbar vertebra, the point of connection between a movable and immovable spinal segment.

### CONCLUSIONS

1. In cases of painful spondylolisthesis a complete relief of the symptoms was obtained in 41.1 per cent of the patients treated conservatively and in 69.2 per cent of the cases treated by spinal fusion.

2. In no instance was a definite progression of the deformity observed, after the treatment by means of braces or posterior spinal fusion had been undertaken.

3. Surgical procedures that endanger the life of the patient are not justified either from the view of the relief of symptoms, or in order to check the progression of the deformity.

4. The presence of a sciatic pain associated to the local spinal symptoms does not necessarily mean that permanent relief can not be obtained unless the disc is removed or cutted. In 55.5 per cent of the cases presenting such a clinical picture, complete relief was obtained either by conservative means or after the fusion of the posterior spine.

5. In advanced cases of spondylolisthesis the spontaneous fusion of the anterior spine after destruction of the intervertebral disc, did not constantly produce complete relief of the symptoms. On the other hand, following the application of a spinal support or the surgical fusion of the posterior spine, all the symptoms disappeared.

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# FUNCTIONAL RESTORATION OF THE THUMB

## Pollicization of the Index

H. KELIKIAN, M.D., F.A.C.S., Chicago, Illinois, and E. W. BINTCLIFFE, M.S., F.R.C.S.

**D**URING the second World War we saw a number of injured hands with the thumb partially or completely ablated. The loss of the thumb deprives the hand of most of its usefulness. The palm can still be used as a paddle and the remaining fingers may serve as hooks. The fingers can by themselves curl around a bar, pluck a chord, scratch, press down, and pinch sideways. Without the thumb, the fingers cannot effectively hold a pen and wield it with skill and speed; the hand as a whole cannot grasp a tool and put it through efficient,

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gainful work. Torque as used in turning a door knob or a screw driver becomes difficult; pulp-to-pulp pinch, or opposition, is lost.

Modern war missiles, especially high explosives, are extremely destructive. Their action is not selective. It is mangling, mixed. They destroy all the structures in their way, shatter the bones and tear the soft tissues into shreds. Not only the thumb is injured, but the other fingers, usually the index and its metacarpal, are involved. Infections of varying severity intervene and add their toll of destruction. It takes time and numerous co-ordinated attempts to salvage a thumb out of this havoc, or reconstruct one when it has already been amputated. It is, of course, desirable that the reconstructed thumb be

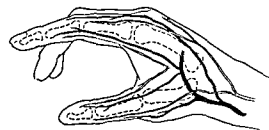


Fig. 1.

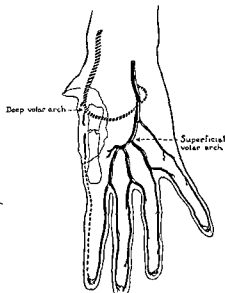


Fig. 2.

Figs. 1 and 2. The surgical anatomy of the ablated thumb with compound fracture of the second metacarpal bone of the hand as caused by gunshot.

Fig. 1. The vessels supplying the thumb and the radial side of the index arise mainly from the radial artery and its continuation, the deep palmar arch. The volar digital artery supplying the radial aspect of the index runs in a dorsal plane closer to the bone; it does not cross the corresponding digital nerve as does the artery on the ulnar aspect of the index (shown in the inset).

Fig. 2. A missile which tears the thumb off and shatters the second metacarpal bone of the hand often severs the volar digital artery which supplies the radial aspect of the index. The digital artery destined to supply the ulnar aspect of the index and emanating mainly from the superficial palmar arch is not involved. The preservation of this artery and its accompanying nerve constitutes the crux of the problem.



Fig. 3.

Fig. 4.

Figs. 3 to 18. The pattern of management as exemplified by Case 1. Donald C. Disarticulation of the right thumb at the carpometacarpal junction and compound fracture of the base of the second metacarpal bone.

Fig. 3. Roentgenogram of the hand.

Fig. 4. Photograph of the hand against the background of the abdominal wall from which a tube graft has been raised. Note the extensive wound which encroaches upon both dorsal and volar surfaces of the hand. Only a small tag of skin is left from the ablated thumb.

Fig. 5. Dorsal incision to deepen the web space between the index and long fingers. *Junctura tendinum* is shown cut.

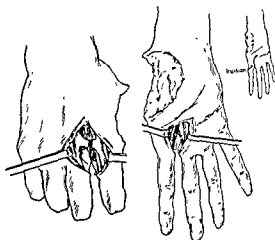


Fig. 5.

Fig. 6.

Fig. 6. Volar incision is deepened by severing the transverse fibers of the palmar aponeurosis. The artery which is destined to supply the radial aspect of the long finger is ligated and cut beyond the bifurcation of the mother trunk. The digital nerves are left undisturbed. The deep or transverse metacarpal ligament is cut, volar and dorsal incisions are joined. Index finger is abducted from the remaining fingers.

painless. It must move in and out of oppositional position: abduct, flex and touch the other finger tips. It must feel or at least distinguish between hot and cold and convey some awareness of shape and position. In many cases that came to our attention primary wound excisions had already been per-

formed in other stations and we often did not know how conserving, yet complete, the initial surgery had been. Military exigencies forced us in turn to evacuate soldiers whom we had begun treating. The follow-up was difficult. We did, however, carry on the work on a number of injured thumbs and complet-



Fig. 7.



Fig. 8.

Fig. 7. The surgical wound between the index and long finger is covered with one end of the previously prepared abdominal tube; the fingers are kept apart with a spreader-splint which is bound to the torso with adhesive tape passing around an attached tongue depressor. The spreader-splint consists of a catheter which is sutured to the finger nails of abducted index and of long fingers. It is made stiff by a Kirschner wire.

Fig. 8. When it is ascertained (6 weeks later) that the

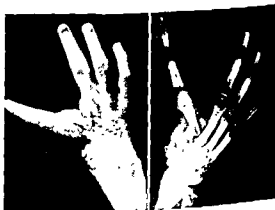


Fig. 9.

Fig. 10.

tube receives sufficient blood from the hand, its other end is released from the abdomen. The tube is opened, trimmed, and made to cover the original wound of the hand and replace the scar-bound skin of the palm.

Fig. 9. Dorsal view of the hand with all wounds covered and suture lines healed.

Fig. 10. Roentgenogram of the hand showing the faulty union of the abducted distal fragment of the second metacarpal bone.

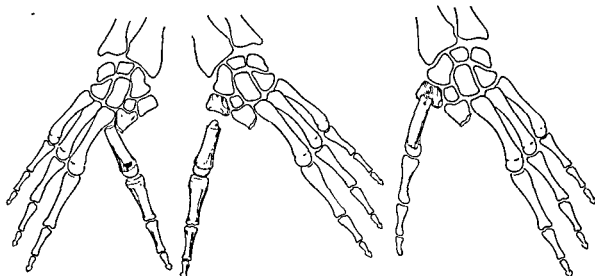


Fig. 11.

Fig. 12.

Fig. 13.

Fig. 11. Osteotomy is performed through the site of faulty union of second metacarpal bone.

Fig. 12. The osteotomized proximal end of the distal fragment of the second metacarpal bone is coned; a cavity is gouged into the distal surface of the greater multangular bone.

Fig. 13. The coned end of the metacarpal of the index is levered into the cavity of the multangular bone. Wire suture is passed to hold the two bones together. The long abductor of the thumb is anchored to the metacarpal of the index. (This part not shown.)

ed the job of reconstruction. It is hoped that a survey of what was done—of the various steps taken—in transferring the index finger to take the place of the missing thumb would not be amiss.

Two representative cases are here essayed.<sup>1</sup> In one the thumb had been disarticulated completely at the carpometacarpal junction and the second metacarpal bone of the hand was fractured at its base; in the other the thumb was disjunctured through the metacarpophalangeal joint and the distal end of the second metacarpal bone had suffered a compound fracture. Both patients were seen by us within 10 days of the original gunshot injury. They were sent to us with the damaged hand enclosed in circular plaster cast. Upon removal of the latter, further examination revealed that in addition to the missing thumb, the second metacarpal bone of the hand had suffered a compound comminuted fracture; the extensor tendons of the index finger were severed but the flexors functioned; finally, the sensibility of the index finger was dulled along its radial aspect but remained intact on the ulnar side. From these findings and from the extent of the wound, it seemed safe to surmise

that the artery emanating from the deep volar arch and destined to supply the radial side of the index finger was probably severed; a similar fate perhaps betook the smaller dorsal twigs which accompany the digital branches

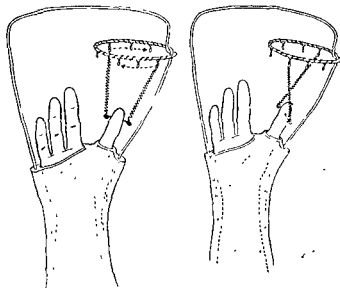


Fig. 14.

Fig. 15.

Fig. 14. Kirschner wire is passed through the distal phalanx of the transposed index and is attached to the rotation splint incorporated in a cast.

Fig. 15. The index is gradually rotated into oppositional position in the ensuing 2 weeks before hard callus could deposit. Too hasty rotation of the index might embarrass its precarious circulation.

<sup>1</sup>Both patients with their reconstructed thumbs were presented at the annual meeting of the British Orthopedic Association at the Royal College of Surgeons, October 26-27, 1945.



Fig. 16.



Fig. 17.



Fig. 18.

Figs. 16 to 18. Functional recovery in Case 1.

Fig. 16. Abduction.

Fig. 17. Pulp-to-pulp opposition.

Fig. 18. Holding a pencil. When this patient was last heard from, he stated that he was working full time as a mail clerk.

of the radial nerve part-way into the index finger; the only sizable blood vessel that maintained the circulation of the damaged index was the volar digital artery which runs along its ulnar aspect; the nerve which accompanies this artery, a branch of the median, constituted the sole pathway of sensation (Figs. 1 and 2). *The preservation of this artery and nerve became our primary concern in trying to pollicize the index finger.* The principles of asepsis, chemotherapy, wound closure, prevention of contractures, immobilization and elevation and functional exercises were also adhered. The entire management resolved itself into a pattern which will be described as it was applied for the case with more radical ablation of the thumb: that with disarticulation at the carpometacarpal junction (Figs. 3 to 18). The management was altered slightly, curtailed and short-circuited, for the case with disarticulation of the thumb through the metacarpophalangeal joint.

#### THE PATTERN OF MANAGEMENT

1. *Examination and appraisal.* The original cast is removed, the wound inspected; the sensation of the index finger and its power to be actively flexed are tested; an x-ray picture of the entire hand is taken. The hand and forearm are then thoroughly washed with soap

and water, wrapped in sterile dressings, splinted and elevated.

2. *Preparation of a pedicled tube (or flap) and revision of the wound of the hand.* The following day, with the patient under general anesthesia, a tube graft (a flap in the milder case) is raised from an appropriate area of the abdomen. The hand wound is then revised all necrotic tissue, foreign particles, detached pieces of bone and blood clot being removed. Hemostasis is procured. The wound is covered with a fine mesh gauze; the hand and the forearm are encased in a skin-snug, well molded cast, the fingers being left free.

A banjo-splint is incorporated in the cast and elastic finger-nail traction is instituted. The limb is elevated. The traction is maintained at night to prevent contracture of the fingers; during wakeful hours it is released and the patient is coaxed actively to flex and extend all undamaged fingers, to flex the index finger against resistance.

3. *Deepening the web-space between the index and long fingers.* When it is made certain (usually about 4 weeks) that the abdominal tube would obtain sufficient blood from its root farthest away from the damaged hand, the other end is lifted with a sizable flap of skin, bearing a thick pad of fat. Under safe and adequate constriction of the arm (blood pressure



Fig. 19.



Fig. 20.



Fig. 21.

Figs. 19 to 32. Variations as exemplified by Case 2. Major H. Disarticulation of the left thumb through the metacarpophalangeal joint with compound fracture of the head of the second metacarpal bone.

Fig. 19. Roentgenogram of the hand soon after gunshot injury, before wound excision.

Fig. 20. Roentgenogram of the hand following wound excision.

Fig. 21. Roentgenogram of the hand showing osteosynthesis of the proximal phalanx of the index to the metacarpal of the thumb which was performed at the same time as closure of the hand wound, deepening of the intermetacarpal cleft and covering this with a freshly raised abdominal flap.

cuff) the web space between the index and long fingers is deepened to about 3 centimeters proximally. The skin incision begins over the dorsum of the hand, in the cleft between the second and third metacarpal bones: It is deepened sufficiently to reveal the band connecting the extensor tendons of the index and long fingers. This junctura tendinum is sharply cut through. The incision is then carried across the interdigital web to the volar surface where it runs proximally, past the distal crease of the palm and then curves ulnarward. The volar incision is deepened cutting through the transverse, interlacing fibers of the palmar aponeurosis. The common arterial trunk which bifurcates into digital vessels for the adjacent sides of the index and long fingers is definitely identified. The digital nerves diverge from their trunk more proximally behind the artery: They are left unmolested. The digital artery going to the radial side of the long finger is carefully isolated. It is doubly ligated well beyond the bifurcation of the common trunk and cut between the two lig-

atures. The deep or transverse metacarpal ligament which binds the adjacent metacarpal heads firmly together is then sought and severed. The distal fragment of the fractured second metacarpal bone, thus freed, can now be abducted radially with the index finger revealing a deep cleft. The latter is bounded on its radial side by the fractured second metacarpal bone and the first volar interosseous muscle; the second dorsal interosseous, the third metacarpal bone and second lumbrical remain on the ulnar aspect of the deepened cleft. The arm constriction is removed (blood pressure cuff is deflated) and all bleeding points are caught and ligated. The deepened web space is covered with the flap of skin at the detached end of the abdominal tube. A catheter, made rigid by passing a Kirschner wire, is sutured to the finger nails of the abducted index and of the long fingers and this spreader-splint is bound to the torso by adhesive tape. Functional exercises are continued. In addition to finger exercises the forearm and elbow are lifted from the belly repeated-





Fig. 22.

Fig. 23.

Fig. 24.

Fig. 22. The hand wound 1 week after it had been casted and elevated—2 weeks after the gunshot injury—and immediately before surgery. Note that wound extends dorsally cutting across the extensor tendons of the index and overlying sensory nerves; it passes radially across the pathway of the artery and nerve destined to supply the radial aspect of the index finger; the flexor tendons which pursue an oblique course along the ulnar side of the wound were not disturbed.

Fig. 23. Abdominal flap is sutured to the deepened intermetacarpal cleft; the primary wound is closed; finger-nail spreader-splint is anchored to the torso.

Fig. 24. The hand is released from the abdomen and the detached flap is made to replace the scar-bound skin in the region of the distal palm.

ly so as to obviate flexion deformity of the wrist.

4. *Release of the hand from the abdomen; covering the original wound; removal of scar-bound skin and its replacement with padded integument.* After it has been definitely made certain that the tube graft receives sufficient blood from the end attached to the hand—after 5 to 6 weeks from the preceding proce-

dures—the other end of the tube graft is detached from the abdomen. The original wound of the hand is refreshed; excess granulation and scar-bound skin is excised; hemostasis is procured. The pedicled tube, anchored into the deepened and widened interdigital web space, is slit open. It is trimmed

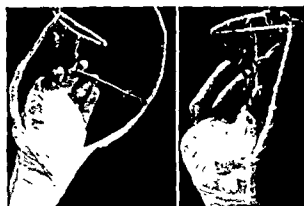


Fig. 25.

Fig. 26.

Fig. 25. Hand in rotation splint.

Fig. 26. Index is gradually rotated into oppositional position.



Fig. 27.

Fig. 28.

Fig. 27. Hand immobilized in final desired position, with the undamaged fingers and the distal joint of the transposed index left free for exercise.

Fig. 28. Functional exercises are carried through the period of immobilization of the damaged parts.



Fig. 29.

Fig. 30.

Figs. 29 to 32. The functional recovery of Case 2.

Fig. 29. Abduction.

Fig. 30. Opposition.



Fig. 31.

Fig. 32.

Fig. 31. Holding a fork.

Fig. 32. Untying a knot. The last heard, this officer had returned to military duty.

until its cut margins definitely bleed and what is fashioned out of it is made to cover the refreshed hand wound. The limb is then encased in a snug circular cast with the fingers left free. It is elevated. Finger exercises are insisted upon.

5. *Osteosynthesis and rotation of the index finger into a position of opposition.* Another 6 weeks are allowed to lapse. By then the distal fragment of the fractured second metacarpal bone has affected a faulty union. Through a dorsal incision, avoiding the previously placed skin grafts, the second metacarpal bone of the hand is osteotomized at about the level of malunion. The incision is extended to the back of the wrist and to its radial border. The severed tendon of the long abductor of the thumb is now sought and secured with the holding suture. The distal surface of the greater multangular bone is exposed and excavated; the proximal end of the distal fragment of the osteotomized second metacarpal bone is coned and inserted into the cavity already gouged in the greater multangular bone. The two bones are transfixed together with a malleable wire suture. The dissected end of the abductor pollicis longus is anchored to the now transposed distal fragment of the second metacarpal bone. The incision is closed, a Kirschner wire is passed through the distal phalanx of the abducted index and cut short. It is connected to a special rotation splint incorporated in the cast. During the ensuing 2 weeks, before hard callus could deposit, the transposed index finger is gradually rotated in a clockwise direction until it comes to face the long, or preferably the ring, finger. It is then held immobilized in an adequate cast so that all undamaged fingers and the distal

joint of the new pollex are left free for exercise.

6. *Functional recovery.* Immobilization is persisted in until firm union has taken place between the two bones: the metacarpal of the index and the greater multangular of the wrist. After the removal of the final cast the patient is coaxed to carry on such co-ordinated useful exercises as holding a pen, a fork, a card. He is encouraged to practice pressing down on a keyboard, grasping a tool and feeding himself. These small feats are easily attained when functional exercises had been carried on throughout the entire management—without the benefit of any special course of re-education.

#### VARIATIONS AND SHORT-CUTS

While the web space is being widened and deepened, it would have been feasible to have temporarily covered the original wound of the hand with a free split thickness graft. In a case to be reported elsewhere, we raised a separate flap for the hand wound at the time one was anchored to the deepened web space. In the case with disarticulation of the thumb at the metacarpophalangeal joint (Figs. 19 to 32) the edges of the gunshot wound were refreshed and sutured together. At the same sitting the web space between the index and long fingers was deepened; the proximal end of the first phalanx of the index and the distal end of the metacarpal of the thumb were divested of their articular cartilages, apposed, and transfixed together with a wire suture; the deepened web space was covered with a freshly raised abdominal flap and spreader-splint was sutured to the finger nails. After 5 weeks the hand was disconnected from the abdomen and the remnants of the skin flap was utilized to

replace the scar-bound skin on the palm; a short Kirschner wire was passed through the distal phalanx of the transposed index and connected to the rotation splint. When the desired position was attained the rotation splint was replaced by a regular plaster cast immobilizing the new pollex and permitting functional exercises.

#### COMMENT

The management described has enabled us successfully to transfer the damaged index finger to take the place of the missing thumb. It is to be noted that the cases here assayed presented relatively fresh wounds and compound fractures—wounds caused by gunshot—gaping wounds that were potentially infect-

ed. To what extent did chemotherapy contribute to this success would be difficult to say. We did administer sulfa drugs and penicillin in usual doses early in the treatment of wounds and for a few days after each major surgical undertaking. But we relied more on surgical care; on avoidance of added damages; on time and proper splintage to promote healing of the injured structures, and on time alone to enhance adequate vascularization of skin grafts. For the case with complete ablation of the thumb, the management was spread over a period of 7 months. The case with disarticulation at the metacarpophalangeal joint took only 4 months. Long lapses of time did not seem as important as restoring these wounded hands to functional usefulness.

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DECEMBER, 1946

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### LOBECTOMY AND PNEUMONECTOMY IN THE TREATMENT OF PULMONARY TUBERCULOSIS

SUFFICIENT experience has been accumulated in the past five or six years to make it possible to predict the place that lobectomy and pneumonectomy are likely to have in the surgical treatment of pulmonary tuberculosis. That it would never be possible to excise all of the tuberculous disease in any patient has been obvious from the beginning. Most surgeons have been surprised in the course of their experience by the fact that the disease is frequently found to be more extensive when the chest is opened than the x-ray had led them to believe. Lobectomy or pneumonectomy is not a substitute for any of the forms of collapse therapy and where one of these procedures is likely to prove effective it should be employed in preference to excision. On the other hand, it must be recognized that there are lesions that are unlikely to be con-

trolled by any of the older methods. To state that thoracoplasty is effective in 90 per cent of cases and carries a low mortality is not an argument against lobectomy or pneumonectomy. It is with the types of cases in which thoracoplasty has proved unsatisfactory that the results of the more radical forms of treatment should be compared.

Patients with well marked bronchial stenosis, particularly if repeated febrile attacks occur or if the sputum continues positive in the involved area, should be submitted to lobectomy or pneumonectomy provided the disease in the remainder of the lung is healed or sufficiently quiescent. The operation should not be undertaken if it will necessitate the division of the bronchus through a site of active disease. Areas of tuberculous bronchiectasis which continue a source of positive sputum should be excised. Hemorrhage from such areas in the lower or middle lobes and usually in the upper lobe should be considered an indication for excision, although in the upper lobes thoracoplasty may be the procedure of choice. Atelectatic lobes or portions of lobes which remain the only source of tubercle bacilli should be removed since no other treatment is effective. Cavities which remain open in the presence of what should be an effective pneumothorax ought to be treated by lobectomy if the condition of the remainder of the lung will permit it. In the case of upper lobe cavities of this type it is sometimes wise to do a preliminary thoracoplasty and face the fact that should the sputum remain positive it may be necessary to do a secondary lobectomy. Lobectomy is also indicated in tuberculosis confined to a lower or middle lobe when because of adhesions the disease is not con-

trolled by pneumothorax or phreniclasia. Solitary large tuberculomas should, as a rule, be removed. Such lesions, whether or not collapse therapy has been employed, are prone to undergo necrosis sooner or later, and not infrequently cause dissemination of the disease. That dissemination occurs occasionally in spite of lobectomy is not a valid argument against the procedure, since it will almost certainly happen much less frequently than with any other form of treatment. Massive tuberculous disease in one lung when the lung on the other side is in good condition may occasionally be an indication for pneumonectomy, but this is a doubtful indication and the percentage of satisfactory results is likely to be disappointing.

The long term results of these procedures, as in other forms of surgical treatment, are certain to be influenced by the postoperative management. Prolonged rest is indicated for all cases, particularly if there has been evidence of activation of apparently quiescent

pre-existing lesions. Although activity may be permitted fairly early following excision of certain unusually localized foci of disease the management should in general be much the same as though the patient had had a thoracoplasty. Many patients continue to have positive cultures from sputum or gastric lavage for some months following operation. In many such patients the source of the positive sputum is not apparent.

Lobectomy and pneumonectomy undoubtedly have a place, although a limited one, in the surgical management of tuberculosis. Too much enthusiasm unquestionably has resulted in the employment of these procedures in unsuitable cases. Fortunately it is in those cases in which the indication is most obvious that the results are most satisfactory. Lobectomy and pneumonectomy represent additions to the many forms of surgical care of tuberculosis, and time and experience alone will determine the lesions for which they are most suitable.

ROBERT M. JAMES

# THE SURGEON'S LIBRARY

## REVIEWS OF NEW BOOKS

IN his book entitled *Pneumoperitoneum Treatment*<sup>1</sup>, Dr. Banyai has presented the subject so thoroughly that it should no longer be considered a therapeutic fad. Although a voluminous literature has been published on various phases of the subject, this is the first comprehensive monograph. The author, a pioneer himself in the use of pneumoperitoneum, recapitulates the literature and reports on his own experience.

After giving the history of the development of pneumoperitoneum treatment, he devotes a considerable amount of space to discussing the technique. However, it was difficult to decide which of the various methods described was the one of choice.

A very complete discussion of the physical and physiological changes produced by pneumoperitoneum, and of the complications encountered in its therapeutic use, furnishes the background for the clinical application of the procedure.

As the author presents the various diseases and pathological conditions for which pneumoperitoneum has been used, he discusses the fundamental processes involved and the apparent manner in which the pneumoperitoneum works.

Pneumoperitoneum has been used for a long time in the treatment of tuberculous peritonitis and enterocolitis and in general has been effective. The types of the disease suitable for it are clearly described.

Its use in the treatment of pulmonary tuberculosis has been the subject of the greatest amount of discussion and of heated differences of opinion. The largest section of the book is devoted to this field and the author summarizes the extensive literature and draws on his own large experience to formulate his conclusions. That pneumoperitoneum is of value in the treatment of certain cases has been established and that it should not be used to the exclusion of all other forms of treatment is a statement that all will accept. As a result of this chapter alone, Dr. Banyai should succeed in convincing everyone that pneumoperitoneum is a method of treatment which should be a part of the armamentarium of everyone treating pulmonary tuberculosis.

Although most physicians are familiar with the use of pneumoperitoneum in the treatment of pulmonary tuberculosis, few realize that it has also been used quite extensively in the treatment of a wide variety of other chest conditions. These other indications for its use are discussed thoroughly, and a clear presentation of the pathological state in each

instance is followed by a summary of the results to be expected and of those obtained. Of particular interest is the discussion of the use of pneumoperitoneum in certain cases of bronchial asthma and of pulmonary emphysema.

In this book Dr. Banyai has succeeded in presenting a very controversial subject in a well balanced and comprehensive manner. No longer should pneumoperitoneum be considered a therapeutic fad. Although the book would be improved by a more complete digest and arrangement of the literature and by the routine use of a summary at the end of each chapter, it is recommended to everyone interested in the treatment of chest disease.

RICHARD H. MEADE, JR.

THE second edition of Saphir's *Autopsy Diagnosis and Technic*<sup>2</sup> hews to the line in its purpose of providing a handbook of autopsy technic and morbid anatomy for the student. The general practitioner and the general pathologist are not beyond the realm of its usefulness. There are 375 pages divided into 26 chapters. Sixty-nine illustrations and 18 tables are helpful accompaniments of the subject matter.

The reviewer heartily endorses the author's idea of the protocol, in Chapter II, page 25. "Too often, autopsy protocols are so packed with irrelevant detail that the reader has difficulty in his attempt to glean the pertinent data from the maze of words offered by the writer."

Religious prejudices to examination of the body after death are adequately disposed of, at least in theory. Unexpected death from natural causes and notes on accidental death are given excellent coverage for the space allotted. The general necropsy technic is treated in a methodical and cogent style.

The student will find the various tables on the differential diagnosis of the morbid processes affecting the major organs of extreme value. Rich's table on the pathogenesis of forms of jaundice has been incorporated to aid the student in the modern interpretation of jaundice, its pathogenesis and concomitant morbid changes. Special attention also has been given to neonatal pathology.

Additions to the text in the second edition are the anatomic changes found in association with certain vitamin deficiencies and tropical diseases. This compact manual well serves its purpose within the limits of its scope.

EUSTACE L. BENJAMIN.

<sup>1</sup>*PNEUMOPERITONEUM TREATMENT*. By Andrew Ladislau Banyai, M.D., F.A.C.P., F.C.C.P. St. Louis: The C. V. Mosby Co., 1946.

<sup>2</sup>*AUTOPSY DIAGNOSIS AND TECHNIC*. By Otto Saphir, M.D. With a foreword by Ludwig Hektoen, M.D. 2d rev. ed. New York: Paul B. Hoeber, Inc., 1946.

THE book by Collens and Boas entitled *The Modern Treatment of Diabetes Mellitus*<sup>1</sup> was designed as a practical, comprehensive guide for the general practitioner who treats diabetic patients, and particularly for those who have not available the services of a competent dietitian. The principles underlying the selection of a suitable dietary formula are explained. The formula decided, the physician (or the patient) can translate it into a menu by copying from the diet calculator supplied with the book. This calculator, about which the chapters on feeding are built, has the merit of simplicity and is one method of prescribing meals with accuracy if not always in good balance or to the satisfaction of the patient. There seems little question but that a trained dietitian can serve the individual patient better and without the need of a calculator at her elbow. Included are chapters on the technique of insulin administration and urine examination, which might well be printed in pamphlet form for the use of the patient.

This book has great value in presenting in clear and readable form material that is seldom presented simply. The procedures of the authors, based on large clinical experience, are definite and logical even as regards controversial details and are, therefore, bound to be helpful to the reader. Commendable, and in line with modern practice, is their emphasis on the efficacy of measured rather than weighed quantitative diets, their emphasis on simplifying instruction, and their selection of formulas that approach as nearly as possible the normal diet.

Clinical differentiation as regards treatment includes the following types: mild diabetes in individuals who are obese, undernourished, and of normal weight; diabetes of moderate severity; and severe diabetes without ketosis, with ketosis, and with uncompensated ketosis. Short chapters on diabetes in children and in pregnancy are included. The chapter on the history of the disease is excellent. The associated degenerative arterial changes of diabetes receive extensive discussion; those of the peripheral arteries are presented at such length that the subject of their treatment merits mention on the title page. The authors have achieved the aims set forth in the preface of their book. Students and physicians will profit by reading and studying it.

WALTER H. NADLER.

THE previous volumes by Saegesser on surgical operative technique and infections of the hand have already served to introduce this Swiss surgeon to the American profession. For many years first assistant to de Quervain, Saegesser has been brought up in the best of European surgical tradition in training and clinical experience. As teacher of clinical surgery with particular interest in the practical problems of surgical technique and therapeutics Saegesser presents his material clearly, methodically, and logi-

cally. *Spezielle Chirurgische Therapie für Studierende und Ärzte*<sup>2</sup> is distinctly more than a book on operative technique. He has noted in the preface the questions he wishes to answer: first, what to do in a certain situation; and, second, how best to do it. These questions he has tried to answer "in simple and understandable fashion . . . without learned frills . . . with the idea that in this way the value of the book would not suffer but rather would be increased."

The volume covers the entire field of general surgery omitting brain tumors, plastic surgery, eye, ear, nose and throat surgery, but it does include sizable chapters on urologic surgery, surgery of the bones and joints including maxillofacial fractures, and compression fractures of the spine as well as a special chapter on cord compression. While this is essentially a treatise on therapy and operative indications and technique, many topics considered are accompanied by succinct discussions of diagnosis, differential diagnosis, preoperative and postoperative care, and gross pathology. In the 270 pages devoted to abdominal surgery, for example, one is very much impressed by the space devoted to preparation of the patient for operation and the discussion of methods for preventing and managing complications post-operatively. The book presents those procedures which Saegesser has found best, for while he admits there are often many ways of doing things in surgery one method is usually the best. The reader is not confused with a wide choice of procedures but is presented with a logical uniform approach to surgery.

There are several places where Saegesser's practice and current American practice differ. One is struck by the absence of reference to preparation in large bowel surgery with the sulfonamides; water and electrolyte balance, protein metabolism and vitamin administration are not stressed as they would be in current American texts. The use of suction in abdominal surgery does not seem to be as much appreciated in Switzerland as it is here. The chapter on burns is quite sketchy and seems particularly incomplete in view of British and American contributions in the past ten years.

These criticisms, however, are of minor significance when the volume is considered as a whole. The subject matter is presented in the fashion such as only a trained teacher can present it and the book will serve as a standard for many years. The nearly two thousand line drawing illustrations are excellently done and add greatly to the value of the text. The volume is well worth reading by the student, the general surgeon, and especially by the teacher of surgery.

MICHAEL L. MASOV.

THE small volume *Human Torulosis*<sup>3</sup> by Leonard B. Cox and Jean C. Tolhurst is a concentrated treatise on the historical, clinical, and experimental aspects of the Torula histolytica. The authors point

<sup>1</sup>THE MODERN TREATMENT OF DIABETES MELLITUS; INCLUDING PRACTICAL PROCEDURES AND PRECAUTIONARY MEASURES. By William S. Collens, B.S., M.D., and Louis C. Boas, A.B., M.D. Springfield, Illinois: Charles C. Thomas, 1946.

<sup>2</sup>SPEZIELLE CHIRURGISCHE THERAPIE FÜR STUDIERENDE UND ÄRZTE. By Max Saegesser, Bern: Hans Huber, 1946.  
<sup>3</sup>HUMAN TORULOSIS. By Leonard B. Cox, M.D., and Jean C. Tolhurst, M.Sc. Melbourne: Melbourne University Press, 1946.

out that the cases of infestation of the human body by torula are unquestionably much more common than they are usually supposed to be. Over a hundred cases have been reported (the greatest number being from the United States), and no doubt the disease is still considered rare—which it should no longer be—simply because it is not recognized. No doubt many patients with "tuberculous meningitis" actually have a torular infestation.

The authors present the detailed case histories of 13 patients of their own who suffered from this disease, and from their own series as well as from a comprehensive review of all available reported cases by other authors, show that the central nervous system is the most commonly affected of all the systems of the body and that death most frequently is from that cause. The lung is the next most commonly involved organ, but actually the yeast-like organism may invade and destroy almost any tissue or organ in the body. The most likely portal of entry, they believe, is through the respiratory tract. The common source of the organism is not completely known, though it is to be found in many soils, and it may even be air borne. Neither is it understood how it may pass from individual to individual, if indeed it may. Within the body the torula may pass through the blood or lymph streams, circulate throughout the cerebrospinal fluid system and thence into the perivascular spaces, or it may pass directly into tissues contiguous with a focus. Torulosis in experimental animals closely resembles the human disease in the matter of locus of lesions in the organs of predilection and in the time element of lesion development.

At present there is no known effective treatment for torular infestation. The drugs of the sulfa group are ineffective, as is penicillin. The salts of some of the heavy metals have been used without result. Some lesions of the lungs apparently heal spontaneously; surgical excision or drainage seems to help effect a cure where such treatment is possible; infestation of the central nervous system is fatal. Many excellent illustrations of the organism and of typical organ lesions are furnished, and as are directions on differential staining of the torula.

JOHN MARTIN.

THE latest member of the series of *General Practice Manuals* is a compact volume<sup>1</sup> designed as an aid to the medical student, the part time anesthetist, and others who may be called upon to employ depressant drugs, alleviate respiratory depression or obstruction, and treat hypoxia or shock. The presentation, therefore, is confined to fundamental and practical considerations of anesthesiology.

In the chapter on preanesthetic medications, a useful table lists the recommended dosage of the various drugs and combinations of drugs for the average patient of the difficult age groups. A particularly timely section is that dealing with the rational treatment of severe drug depression.

<sup>1</sup>ANESTHESIA IN GENERAL PRACTICE. By Stuart C. Cullen, M.D. Chicago: The Year Book Publishers, Inc., 1946.

No other single factor is as essential to a safe and satisfactory anesthesia as the establishment and maintenance of a perfect airway, and this point has been stressed, as have the undesirable effects resulting from an inadequate airway. Following is a discussion of the common sites of respiratory obstruction and the symptoms of this condition and their alleviation.

The pharmacology of curare and the technique of its use as an adjunct to inhalation anesthesia is presented in some detail. This is a procedure in which the author has pioneered and he is well qualified to speak with authority on this subject.

The four pages of cartoons regarding the correct and incorrect management of toxic reactions of local drugs are clever and instructive.

A number of relatively simple nerve blocks which serve a useful purpose in general practice are presented in some detail. Table 2 shows in graphic form the essential properties of the drugs used for nerve block and spinal anesthesia.

Moon's valuable diagram of precipitating and perpetuating factors in secondary shock and a chart of physiopathologic changes during the development of shock are useful inclusions in the chapter on the recognition and treatment of shock.

It is emphasized that the recognition of incipient hypoxia and the prompt institution of oxygen therapy are essential factors in the securing of good results. The signs of oxygen want, types of hypoxia, and the physiology of oxygen transport are outlined. The methods of administration of oxygen are illustrated.

An appendix deals, in outline form, with the anesthetic agents available for office use.

The author has achieved his purpose in a clear, concise presentation of the material in this text. No new or controversial concepts have been included, but a comprehensive and instructive manual has been prepared. The volume is well arranged, of attractive format on good stock. It will be of value not only to the student, but to the teacher as well.

MARY POE.

THE book *Urologic Roentgenology* by Miley B. Wesson<sup>2</sup> is an authoritative volume by an outstanding urologist of brilliant scientific background and long clinical experience. The author has drawn upon his own large material as well as that of many others to produce a very fine series of representative roentgenograms which are reproduced with remarkable detail and texture.

The numerous illustrations are an atlas in themselves and in the relatively brief accompanying text the subject of urography is very completely covered. Intravenous as well as retrograde urography is discussed at length, including the indications, technique, and complications.

With the widespread use of intravenous urography too much reliance has been placed upon this procedure alone for diagnosis. The author, therefore,

<sup>2</sup>UROLOGIC ROENTGENOLOGY. By Miley B. Wesson, M.D. and rev. ed. Philadelphia: Lea & Febiger, 1946.



stresses the need for complete urinary tract studies including retrograde urography to confirm findings.

The technique of interpretation is described at length and the diagnosis is not considered empirically but the underlying pathology and the mechanism of the pyelographic changes are presented.

The material which could well have occupied a much larger volume has been condensed to 252

pages; but thanks to careful editing and skillful writing, it makes for easy and pleasant reading. The chapter on congenital anomalies is especially well presented.

This book, which is intended mainly as a guide for the beginner, can be recommended as well to the experienced urologist, for it contains much practical information.

FREDERICK LIEBERTRAL

## BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

**HARVEY CUSHING; A BIOGRAPHY.** By John F. Fulton. Springfield: Charles C Thomas, 1946.

**OPERATIVE GYNECOLOGY.** By Richard W. Te Linde, M.D. Philadelphia, London, Montreal: J. B. Lippincott Co., 1946.

**ACIDOSIS; CLINICAL ASPECTS AND TREATMENT WITH ISOTONIC SODIUM BICARBONATE SOLUTION.** By Esben Kirk, M.D. Copenhagen, Denmark: Ejnar Munksgaard, 1946.

**MEDICAL USES OF SOAP.** Edited by Morris Fishbein, M.D. Philadelphia, London, Montreal: J. B. Lippincott Co., 1946.

**VICTORY OVER PAIN; A HISTORY OF ANESTHESIA.** By Victor Robinson, M.D. New York: Henry Schuman, 1946.

**THE CENTENNIAL OF SURGICAL ANESTHESIA; AN ANNOTATED CATALOGUE OF BOOKS AND PAMPHLETS BEARING ON THE EARLY HISTORY OF SURGICAL ANESTHESIA.** Compiled by John F. Fulton, M.D., and Madeline E. Stanton, A.B. New York: Henry Schuman, 1946.

**MEMOIR ON SULPHURIC ETHER 1847.** By W. T. G. Morton. New York: Henry Schuman, 1946.

**DISEASES OF THE BASAL GANGLIA AND SUBTHALAMIC NUCLEI.** By D. Denny-Brown, M.D., C.H.B., Dr PHIL., F.R.C.P. Edited by Henry A. Christian, A.M., M.D., LL.D., Sc.D. (Hon.), F.A.C.P., Hon.F.R.C.P. (Can). (Reprinted from *Oxford Loose-Leaf Medicine* with the same page numbers as in that work.) New York: Oxford University Press, 1946.

# CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

W. EDWARD GALLIE, TORONTO, *President*

IRVIN ABELL, LOUISVILLE, *President-Elect*

*Cleveland Committee on Arrangements*

THOMAS E. JONES, *Chairman*: JOHN W. HOLLOWAY, *Secretary*

ARTHUR H. BILL

ABRAM B. BRUNER

JOHN F. CORRIGAN

CLARENCE W. ENGLER

SAMUEL O. FREEDLANDER

C. LEE GRABER

JOHN E. HANNIBAL

CARL H. LENHART

OLIVER A. WEBER

THEODORE A. WILLIS

## PRELIMINARY PROGRAM FOR THE 1946 CLINICAL CONGRESS IN CLEVELAND—DECEMBER 16 TO 20

THE five-day Clinical Congress of the American College of Surgeons will open in Cleveland on Monday morning, December 16, at 9:30 o'clock. Headquarters will be in the Cleveland Public Auditorium, and the Statler and Cleveland hotels, with most of the sessions, except the clinics at the hospitals, being held in the Auditorium. Outlines of the programs appear on following pages. They show an interesting and varied plan of presenting wartime and postwar developments in surgery through the media of operative and nonoperative clinics, demonstrations, symposia, panel discussions, forums, motion pictures, and exhibits.

The program of the Congress will include the twenty-fifth annual Hospital Standardization Conference, which will convene during the first four days, with morning and afternoon sessions on Monday through Thursday beginning at 9:30 o'clock and 2:00 o'clock, respectively, and evening meetings on Tuesday and Wednesday beginning at 7:30. Breakfast conferences are also scheduled on Wednesday and Thursday mornings.

The first event on the Clinical Congress program will be the General Assembly for surgeons and hospital representatives which will be held on Monday morning. The Monday afternoon program will include two panel discussions, one beginning at 1:30, the other at 3:30; clinics in the local hospitals; a hospital conference; and a surgical film exhibition. The Monday evening program will be devoted to the Presidential Meeting.

On the four mornings beginning Tuesday at 8:00 o'clock, operative and nonoperative clinics

will be held in the local hospitals. From 9:00 to 12:30 on each of these mornings, the Forum on Fundamental Surgical Problems will meet in two sections—one section in the Music Hall and the other in the Ballroom of the Cleveland Public Auditorium. From 9:30 to 12:30, Tuesday through Thursday, hospital conferences will be held in Club Room B of the Auditorium. From 9:30 to 11:00 o'clock on Tuesday through Friday, surgical film exhibitions are scheduled on ophthalmology and otorhinolaryngology and from 10:00 to 12:00 o'clock on general surgery. At 11:00 o'clock on Tuesday through Thursday, panel discussions on ophthalmology and otorhinolaryngology will be held.

Afternoon programs each day include clinics; two major panel discussions from 1:30 to 3:00 and from 3:30 to 5:00 o'clock respectively (except Thursday when only the 3:30 panel will be held); hospital conferences (Monday through Thursday); and surgical film exhibitions. In addition, on Tuesday afternoon at 2:00 o'clock there will be a symposium on fractures and other traumas; on Wednesday afternoon at 2:00 o'clock a symposium on cancer; on Thursday afternoon at 3:00 o'clock a panel discussion on graduate training in surgery; and on Friday afternoon six concurrent specialty panels from 2:00 to 5:00 o'clock in the fields of obstetrics, plastic surgery, neurological surgery, thoracic surgery, urology, and orthopedic surgery.

Symposia on general surgery will be held on Tuesday, Wednesday, and Thursday evenings; symposia on ophthalmology and on otorhinolaryngology on Tuesday and Thursday evenings; and

a symposium on plastic surgery of the head and neck on Wednesday evening. The concluding event of the Clinical Congress will be the Convocation to be held on Friday evening at 8:15 o'clock in the Music Hall of the Cleveland Public Auditorium.

#### CLINICAL PROGRAM

With the aid of a representative in each hospital, a committee on arrangements appointed by the surgeons of Cleveland, with Dr. Thomas E. Jones as chairman and Dr. John W. Holloway as secretary, has prepared a preliminary program which is published in succeeding pages. This consists of operative and nonoperative clinics, demonstrations, presentation of cases, symposia, pathological conferences, and surgical staff conferences.

Eighteen hospitals are listed in this preliminary outline, and the program for each hospital is classified according to specialties. A wide range of subjects is covered, including general surgery, pathology, fractures and other traumas, thoracic surgery, tumor surgery, plastic surgery, ophthalmology, otolaryngology, neurosurgery, vascular surgery, orthopedic surgery, obstetrics and gynecology, genitourinary surgery, oral surgery, and roentgenology.

The clinics and demonstrations will be held in the hospitals every morning and afternoon beginning Tuesday, December 17.

A complete detailed clinical program for each day will be posted in the form of bulletins at headquarters in the Cleveland Public Auditorium during the afternoon of the preceding day and the program will be distributed in printed form each morning.

#### HOSPITALS AND REPRESENTATIVES

City Hospital	J. H. LAZZARI
Cleveland Clinic	ROBERT S. DINSMORE
Evangelical Deaconess	OLIVER A. WEBER
Fairview Park Hospital	W. E. SMITH
Glenville Hospital	JACOB E. TUCKERMAN
Grace Hospital	L. J. STERNICKI
Huron Road Hospital	HENRY W. BROWN
Lakeside Hospital	FREDERICK R. MAUTZ
Lakewood Hospital	C. LEE GRABER
Lutheran Hospital	FRANK S. GIBSON
MacDonald House	R. L. FAULKNER
Mt. Sinai Hospital	RODOLPH S. REICH
Polyclinic Hospital	HENRY A. SCHLINK
St. Alexis Hospital	JOHN F. CORRIGAN
St. Ann's Hospital	E. P. MONAGHAN
St. John's Hospital	FARRELL T. GALLAGHER
St. Luke's Hospital	DONALD M. GLOVER
St. Vincent Charity	OLIVER A. WEBER
U. S. Marine Hospital	MARK E. MEYERS
U. S. Veterans Hospital	PHILIP F. PARTINGTON
Woman's Hospital	ERNEST COX

#### GENERAL ASSEMBLY

The Clinical Congress will open with a general assembly in the Music Hall of the Cleveland Public Auditorium at 9:30 o'clock on Monday morning. Dr. W. Edward Gallie, President of the College, will preside at this meeting which will be the opening session of the twenty-fifth annual Hospital Standardization Conference. Dr. Irvin Abell, Chairman of the Board of Regents, will report on the progress of the 1946 Hospital Standardization survey, final results of which, including the Approved Lists of hospitals, cancer clinics, and approved hospitals for graduate training in surgery, will be announced at the end of the year.

An address on "Maintaining our Voluntary Hospital System" will be given by Rev. Monsignor Maurice F. Griffin of Cleveland. Dr. Arthur C. Bachmeyer of Chicago, Director of Study of the Commission on Hospital Care, will present "Pertinent Findings from the National Survey by the Commission on Hospital Care."

The program will conclude with a discussion of the nursing problem. Dr. Howard C. Naffziger of San Francisco, Professor of Surgery, University of California Medical School and Chairman of the Committee on Nursing, American Surgical Association, will present the viewpoint of the surgeon. Dr. Robin C. Buerki of Philadelphia, Director, University Hospitals and Dean of the Graduate School of Medicine, University of Pennsylvania, will present the viewpoint of the hospital administrator. Lucile Petry of Washington, Director of Nursing, United States Public Health Service, will present the viewpoint of the nurse.

#### PRESIDENTIAL MEETING

The Presidential Meeting will be held on Monday evening in the Music Hall of the Auditorium. The officers, regents, and distinguished guests will participate in the processional. Dr. W. Edward Gallie, President of the College, will preside. The address of welcome will be given by Dr. Thomas E. Jones, Chairman of the Cleveland Committee on Arrangements; distinguished guests will be introduced by Dr. Arthur W. Allen, Vice Chairman, Board of Regents; and Doctor Gallie will deliver the Presidential Address. An inaugural ceremony will be held for the incoming officers: President, Dr. Irvin Abell of Louisville; First Vice President, Dr. Leland S. McKittrick of Boston; Second Vice-President, Dr. F. Phinizy Calhoun of Atlanta.

The first Martin Memorial Lecture will be a feature of the Presidential Meeting this year. Dr. Edward D. Churchill of Boston has accepted the invitation to give this lecture, and his subject will be "The American Surgeon, A. U. S." The lec-

tureship was established upon motion of the Board of Regents at its midyear meeting on April 1, as a memorial to both Dr. Franklin H. Martin and Mrs. Martin. The founder of the College and of SURGERY, GYNECOLOGY AND OBSTETRICS, was joined by his wife in making the College the beneficiary at their deaths of the Journal, together with its physical plant operated by the Surgical Publishing Company of Chicago, of which they were the owners. Doctor Martin died in 1935 and Mrs. Martin in 1945.

The Martin Memorial Lecture, to be given annually during the Clinical Congress, and dealing with a scientific subject of the author's choosing, supplants the Annual Oration in Surgery.

#### CONVOCATION

The Convocation will be held on Friday evening in the Music Hall. It will open with a processional of officers, regents, governors, and initiates. The President, Dr. Irvin Abell, will preside and will confer the fellowships and the honorary fellowships. Dr. Arthur W. Allen, vice chairman of the Board of Regents, will present the candidates for fellowship.

Several hundred surgeons who have been received into fellowship *in absentia* during the war years in which no Convocation was held, will be added to the number of initiates for the current year who will be present to participate in the initiation ceremonies. The Convocation and in fact the meetings throughout the Congress will be occasions for reunion with many Fellows who have recently returned from service with the military forces.

#### FORUMS ON FUNDAMENTAL SURGICAL PROBLEMS

The Forums on Fundamental Surgical Problems will be conducted on Tuesday, Wednesday, Thursday, and Friday mornings from 9:00 to 12:30 o'clock, with two sessions held concurrently each morning, one in the Music Hall, the other in the Ballroom. Included in them will be brief reports of original clinical and experimental observations relating to the broad aspects of surgery and the surgical specialties. No prepared discussions of the reports are planned, but questions and comments will be invited. Especially keen interest is expected in these sessions this year because of the accumulation of the results of 5 years of work since the last Clinical Congress. Dr. Owen H. Wangenstein of Minneapolis, chairman of the committee which is planning the program, is working toward representation of as many as possible of the various university departments of surgery

in this presentation of clinical and experimental research work.

The enlistment of the interest of young men who are doing original work, through the forums, is one of the most beneficial results of these sessions which are now considered to be an indispensable feature of every Clinical Congress.

#### GENERAL SURGERY

The evening symposia in general surgery on Tuesday, Wednesday, and Thursday, will be held at 8:00 o'clock in the Music Hall of the Public Auditorium. The subject for Tuesday night is "Care of the Patient Before and After Operation." The subject for Wednesday night is "Venous Thrombosis and Prevention of Pulmonary Embolism," to be followed by the annual Fracture Oration which will be delivered by Dr. Edwin W. Ryerson of Chicago, the subject being "Modern Methods in the Treatment of Fractures." The subject for Thursday night is "Antibiotic and Chemotherapeutic Agents in Surgery."

The subjects for the afternoon panel discussions in general surgery on Monday through Friday afternoons are as follows: "Rehabilitation of the Surgical Patient and Early Ambulation" on Monday at 1:30; "The Treatment of Cancer of the Large Bowel" on Monday at 3:30; "Thiouracil in Thyroid Disease" on Tuesday at 1:30; "Recent Trends in the Management of Carcinoma of the Cervix" on Tuesday at 3:30; "Anesthesia" on Wednesday at 1:30; "Protein Metabolism in the Surgical Patient" on Wednesday at 3:30; "Spinal Cord Injuries" on Thursday at 3:30; "Surgery of the Stomach" on Friday at 1:30; and "Surgery of the Vascular System" on Friday at 3:30.

#### OPHTHALMOLOGY

The evening symposia in ophthalmology on Tuesday and Thursday will be held at 8:00 o'clock in South Hall B of the Cleveland Public Auditorium. "Orbital Reconstruction Including Prosthesis" will be the subject on Tuesday evening and several subjects will be discussed on Thursday. Panel discussions on "Retinal Detachment," "Glaucoma," and "Keratoplasty," respectively, are scheduled for Tuesday, Wednesday, and Thursday mornings at 11:00 o'clock.

#### OTORHINOLARYNGOLOGY

The evening symposia in otorhinolaryngology on Tuesday and Thursday will be held at 8:00 o'clock in South Hall C of the Cleveland Public Auditorium. "Treatment of Deafness" will be the subject on Tuesday evening and "Surgery of the Nasal Accessory Sinuses" on Thursday.

Panel discussions on "The Treatment of Ménière's Disease," "Osteomyelitis of the Skull," and "Rehabilitation of the War Deafened," respectively, are scheduled for Tuesday, Wednesday, and Thursday mornings at 11:00 o'clock.

#### PLASTIC SURGERY OF THE HEAD AND NECK

A special symposium on plastic surgery of the head and neck will be held on Wednesday evening at 8:00 o'clock in Club Room B. This symposium will be of interest to many general surgeons as well as to ophthalmologists and otorhinolaryngologists. The following subjects will be discussed: "Cancellous Bone Grafts to the Jaw"; "Repair of Nasal Defects with Free Composite Grafts of Skin and Cartilage from the Ear"; "Studies in the Anatomy and the Repair of Cleft Palate"; and "Preservation of Function Following Resections of Jaw Tumors."

#### SYMPOSIUM ON FRACTURES AND OTHER TRAUMAS

"Advances from War Experience" is the general theme of the symposium on fractures and other traumas which has been arranged by Dr. Robert H. Kennedy of New York, chairman of the Committee on Fractures and Other Traumas of the American College of Surgeons. The aim is to give a rapid survey of worthwhile gains made during the war which may prove of lasting value in the field of trauma. This meeting will be held at 2:00 p.m. on Tuesday in the Ballroom of the Public Auditorium. From the outline shown on a succeeding page it will be seen that an impressive panel of 19 speakers will discuss different phases of the subject and that their presentations will be summarized by Vice Admiral Ross T. McIntire, Surgeon General of the United States Navy; Major General Norman T. Kirk, Surgeon General of the United States Army; and Major General Paul R. Hawley, Chief Medical Director of the United States Veterans Administration.

#### SYMPOSIUM ON CANCER

A symposium on cancer, sponsored by the Cancer Committee of the College, will be held at 2:00 o'clock on Wednesday afternoon in the Ballroom of the Cleveland Public Auditorium. Dr. Frank E. Adair, chairman of the committee, will preside. The subjects to be discussed are the following: "Surgical Treatment of Cancer of the Pancreas," "Resections of Abdominal Cancer Infiltrating the Abdominal Wall," "Hormone Therapy in Cancer of the Prostate," "Estrogen Therapy in Cancer of the Breast," "Testosterone in Cancer of the Breast"; and "Observations on the Genetic Nature of Gastric Cancer in Mice."

#### GRADUATE TRAINING IN SURGERY

A panel discussion on graduate training in surgery and the surgical specialties will be held Thursday afternoon at 3:00 o'clock in the Ballroom. Discussion will be from the standpoints of the American College of Surgeons, the basic medical sciences, the Veterans Administration, the university-connected hospital, and the hospital which is not connected with a university.

#### HOSPITAL STANDARDIZATION CONFERENCE

The twenty-fifth annual Hospital Standardization Conference will open on Monday morning at 9:30 o'clock with the joint session for surgeons and hospital representatives in the Music Hall of the Public Auditorium. The program for this General Assembly has been outlined previously.

The Monday afternoon session will be held in the Ballroom of the Public Auditorium and will consist of a panel discussion on current problems and the immediate outlook in nursing service, conducted by John H. Hayes of New York, President of the American Hospital Association. Among the subjects included will be the following: "Nursing Standards as Affected by Personnel Policies," "Postwar Student Nurse Recruitment Problems," "The Training of a Secondary Group for Nursing Service," and "Nursing Education and Nursing Service."

The Tuesday morning session will be held in Club Room B of the Public Auditorium and will consist of a panel discussion on the securing of complete and scientific medical records. The chairman, Everett W. Jones of Chicago, Vice President of the Modern Hospital Publishing Company, will discuss, "Status of Medical Records in Hospitals as I have Observed Them," following which the program of the American Association of Medical Record Librarians to improve medical record science will be presented. The importance of complete and scientific medical records will then be discussed by different speakers from the standpoints of better care of the patient, training of interns and residents, and the advancement of medical science. The meeting will conclude with a round table conference.

The Tuesday afternoon session in Club Room B will be devoted to a panel discussion on "Extending General Hospital Service to all Types of Patients," with Dr. Herman Smith of Chicago, hospital consultant, presiding. Trends in the care of pital consultant, presiding. Trends in the care of psychiatric, tuberculous, chronically ill, and orthopedic patients will be discussed by authoritative speakers. The concluding talk will be on "Integration of Health Services in the Community" by Graham L. Davis of Battle Creek,

# PRELIMINARY PROGRAM—1946 CLINICAL CONGRESS

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President-Elect of the American Hospital Association.

Tuesday evening in the Little Theatre of the Cleveland Public Auditorium there will be a joint session for hospital trustees, medical staff officers, and administrators, with Dr. Fred G. Carter of Cleveland presiding.

Wednesday morning at 7:45 a breakfast conference on hospital public relations will be held at the Hotel Statler.

The responsibility of the administrative staff in handling emergencies coming to the hospital and discussion on Wednesday morning at 9:30 in Club Room B of the Public Auditorium, which will be conducted by Dr. Frank R. Bradley of St. Louis, Director of Barnes Hospital and President of the American College of Hospital Administrators.

The Wednesday afternoon meeting in Club Room B will consist of a panel discussion on the training of hospital personnel. This will be conducted by Dr. Claude C. Munger of New York, Administrator of St. Luke's Hospital, and Director of the school of hospital administration at Columbia University. Subjects for discussion include the following: "University Training for Hospital Administration"; "Establishing Administrative Internships or Residencies on a High Educational Level"; "Training Supervisory Personnel," and "Training Personnel Managers."

The meeting on Wednesday evening in the Little Theatre of the Public Auditorium will consist of a round table conference on current hospital problems. This will be conducted by Dr. Harvey Agnew of Toronto, Secretary of the Canadian Hospital Council.

The Thursday morning program will begin with a breakfast conference at 7:45 at the Statler Hotel on the subject, "The Point Rating System as Applied to Hospitals," with Dr. Malcolm T. MacEachern presiding. At 9:30 in Club Room B of the Public Auditorium there will be a panel discussion on management techniques and personnel relations conducted by James A. Hamilton of Minneapolis.

The Thursday afternoon program will consist of two sessions. The first, to be held from 2:00 to 5:00 o'clock in Club Room B, will be a panel discussion on problems of the small hospital conducted by Jane Davis of Niles, Michigan, superintendent of Pawating Hospital. The second will be held in the Ballroom from 3:00 to 5:30 o'clock and will be a joint conference of hospital representatives and surgeons on graduate training in surgery and the surgical specialties, with Dr. Robin C. Buerki of Philadelphia.

## ASSEMBLY OF INITIATES

The Assembly of Initiates will be held on Friday afternoon in the Ballroom of the Cleveland Public Auditorium. Dr. Irvin Abell, president, will preside. "The Program of the American College of Surgeons" will be discussed by Dr. Malcolm T. MacEachern, Dr. Bowman C. Crowell, and Major General Charles R. Reynolds (Ret.). Dr. Arthur W. Allen, vice chairman, Board of Regents, will speak on "Fellowship in the American College of Surgeons." The program will close with the recital of the fellowship pledge by the initiates.

## NATIONAL AND REGIONAL FRACTURE COMMITTEES

The meeting of the National and Regional Fracture Committees, with Dr. Robert H. Kennedy, of New York, chairman of the National Committee, presiding, will be held on Wednesday afternoon in Club Room A of the Cleveland Public Auditorium, when this assembly of surgeons will discuss the activities of the respective groups. Working in co-operation with the American Red Cross, these committees have exerted great influence in other local organizations and public officials, improving methods and facilities for the transportation of the injured. They have also made a concerted effort to improve the treatment of fractures in the hospitals of many communities. Pertinent problems will be discussed at the meeting of these committees.

## ANNUAL MEETING OF COMMITTEES

The annual meetings of the State and Provincial Judiciary, Credentials, and Executive Committees will be held on Wednesday morning in the Ballroom of the Hotel Statler. These committees have an important function to perform in the College. The Credentials Committees and the Committees on Applicants constitute one of the largest and most carefully deliberate accrediting bodies which exist in the medical profession. Through this organization the standards of fellowship are maintained and each Fellow of the College has a definite responsibility in this work. All members of these committees are urged to attend this important meeting.

## ANNUAL MEETING OF FELLOWS

The annual meeting of the Governors and Fellows will be held on Thursday afternoon at 1:45. There will be election of officers and governors. The annual meeting affords the Fellows of the College an opportunity to hear reports of officials on the work of the organization, and to learn how it has not only raised the professional and ethical

standards of surgery, but has also promoted good hospitalization and general improvement in the practice of medicine in the United States and Canada. Each Fellow has a personal part in this work and may extend the influence of the College materially in his local community. Hospital Standardization alone offers him unlimited opportunity to provide better medical care for his patients in the hospital in which he works, through continuous progress in applying the principles of the Minimum Standard which insure the best care of the patient.

Every Fellow will want to attend this important meeting, at which reports will be presented on finances; Hospital Standardization; Graduate Training in Surgery; Medical Motion Pictures, Publications; Public Relations; Library and Literary Research; the work of the state and provincial credentials committees, committees on applicants, and the Committee on History Reviews; Sectional Meetings, 1946; and the Department of Clinical Research, including cancer clinics, Medical Service in Industry, Cancer Committee, and the Committee on Fractures and other Traumas. Dr. Abell will report on administration of the College, staff changes, and retirements, and Dr. Arthur W. Allen, Vice-Chairman of the Board of Regents will discuss "Fellowship Obligations and Opportunities."

#### MEDICAL MOTION PICTURES

The latest available films showing surgical procedures and related subjects will be shown in the medical motion picture exhibits which will be held daily. Films on general surgery will be shown in the Little Theatre and films on ophthalmology and otorhinolaryngology in South Hall A of the Cleveland Public Auditorium. These are a much appreciated feature of the Clinical Congress. Despite the decrease in production of such films during the war period, a surprising number of new pictures on varied subjects are being received by the American College of Surgeons for review. Both sound and silent, colored films will be shown, all of which have been approved by the Committee on Medical Motion Pictures.

#### TECHNICAL AND SCIENTIFIC EXHIBITION

The technical exhibit, together with the registration and clinic ticket bureaus, will be held in the Arena of the Cleveland Public Auditorium. Leading manufacturers of surgical instruments, x-ray apparatus, sterilizers, operating room lights, ligatures, dressings, hospital apparatus and supplies of all kinds, pharmaceuticals, and publishers of medical books will be represented in the exhibi-

tion. The technical exhibits will demonstrate many of the newer features learned from our experience in the war.

#### REGISTRATION

Fellows of the College whose dues are paid to December 31, 1945, initiates of the classes of 1942 through 1946, and Fellows in military service will not be required to pay a registration fee for the Clinical Congress. For endorsed junior residents the fee is \$5.00. Surgeons, not Fellows, who attend as invited guests of the College will pay a registration fee of \$10.00.

Although the hospitals of Cleveland afford accommodations for a considerable number of visiting surgeons, attendance at the Congress will be limited to the number that can be comfortably accommodated at the various meetings, as well as by the local hotels. It is anticipated, therefore, that surgeons who are planning to attend the Congress will have registered for the Congress and will also have a confirmed hotel reservation in advance.

#### HOTEL SITUATION IN CLEVELAND

As a result of the great number of early registrants, practically all of the available hotel space in Cleveland has already been reserved. A number of the Fellows desiring to attend this Congress have been unable to the present time to secure hotel accommodations, and their names have now been placed on a waiting list with the Cleveland Convention Bureau.

The Officers and Regents of the College wish to do all they can to aid in obtaining accommodations for all who want to attend. Arrangements have been made with the Cleveland Convention Bureau to care for a considerable number in private homes in the Cleveland area as well as in the Mayflower and Portage hotels in nearby Akron, which has frequent train and bus service to Cleveland. The average running time of these services from Akron to Cleveland is about one hour, and if the situation warrants, an effort will be made to provide chartered bus service.

Those who desire to attend this Congress and have yet been unable to secure a room reservation in Cleveland should write immediately to Mr. Edward C. Brennan, Executive Director, Cleveland Convention Bureau, 511 Tower Building, Cleveland, Ohio. The accommodations desired, the dates of arrival and departure should be given. Information should also be furnished as to whether a reservation in a private home in Cleveland or in an Akron hotel would be acceptable if a reservation in a Cleveland hotel is not available.

# CLINICAL CONGRESS PROGRAM IN BRIEF

UNLESS OTHERWISE DESIGNATED, THE MEETING ROOMS LISTED ARE IN THE CLEVELAND PUBLIC AUDITORIUM

## Monday

- 9:30 General Assembly for Surgeons and Hospital Representatives, Music Hall
- 1:30 Panel Discussion, Music Hall
- 2:00 Hospital Conference, Ballroom
- 2:00 Surgical Film Exhibition (General), Little Theatre
- 3:30-5:00 Panel Discussion, Music Hall
- 8:15 Presidential Meeting, Music Hall

## Tuesday

- 8:00 Clinics, Demonstrations and Group Conferences, Selected local hospitals
- 9:00 Forum on Fundamental Surgical Problems, Section A, Music Hall; Section B, Ballroom
- 9:30 Hospital Conference, Club Room B
- 9:30 Surgical Film Exhibition (Ophthalmology and Otorhinolaryngology), South Hall A
- 10:00 Surgical Film Exhibition (General), Little Theatre
- 11:00 Panel Discussions
  - Ophthalmology, South Hall B
  - Otorhinolaryngology, South Hall C
- 1:30 Panel Discussion, Music Hall
- 2:00 Clinics, Demonstrations and Group Conferences, Selected local hospitals
- 2:00 Hospital Conference, Club Room B
- 2:00 Symposium on Fractures and Other Traumas, Ballroom
- 2:00 Surgical Film Exhibition (General), Little Theatre
- 3:30 Panel Discussion, Music Hall
- 7:00 Surgical Film Exhibition (Ophthalmology and Otorhinolaryngology), South Hall A
- 7:30 Hospital Conference, Little Theatre
- 8:00 Symposium, General Surgery, Music Hall
- 8:00 Symposium, Ophthalmology, South Hall B
- 8:00 Symposium, Otorhinolaryngology, South Hall C

## Wednesday

- 7:45 Hospital Breakfast Conference, Lattice Room, Hotel Statler
- 8:00 Meeting of Cancer Committee, Tavern Room, Hotel Statler
- 8:00 Clinics, Demonstrations and Group Conferences, Selected local hospitals
- 9:00 Forum on Fundamental Surgical Problems, Section A, Music Hall; Section B, Ballroom
- 9:30 Hospital Conference, Club Room B
- 9:30 Surgical Film Exhibition (Ophthalmology and Otorhinolaryngology), South Hall A
- 10:00 Surgical Film Exhibition (General), Little Theatre

### State and Provincial Committees:

- 9:30 Executive Committees, Ballroom, Hotel Statler
- 10:15 Credentials Committees and Committees on Applicants, Ballroom, Hotel Statler
- 11:00 Judiciary Committees, Ballroom, Hotel Statler
- 11:00 Panel Discussions
  - Ophthalmology, South Hall B
  - Otorhinolaryngology, South Hall C
- 12:00 Meeting of Board of Governors, Lattice Room, Hotel Statler
- 1:30-3:00 Panel Discussion, Music Hall
- 2:00 Clinics, Demonstrations and Group Conferences, Selected local hospitals
- 2:00 Symposium on Cancer, Ballroom
- 2:00 Surgical Film Exhibition (General), Little Theatre

- 2:30 Hospital Conference, Club Room B
- 3:30-5:00 Panel Discussion, Music Hall
- 3:30 National and Regional Fracture Committees, Club Room A
- 7:00 Surgical Film Exhibition (Ophthalmology and Otorhinolaryngology), South Hall A
- 7:30 Hospital Conference, Little Theatre
- 8:00 Symposium, General Surgery, Music Hall
- 8:00 Symposium, Plastic Surgery of the Head and Neck, Club Room B

## Thursday

- 7:45 Hospital Breakfast Conference, Lattice Room, Hotel Statler
- 8:00 Clinics, Demonstrations and Group Conferences, Selected local hospitals
- 9:00 Forum on Fundamental Surgical Problems, Section A, Music Hall; Section B, Ballroom
- 9:30 Hospital Conference, Club Room B
- 9:30 Surgical Film Exhibition (Ophthalmology and Otorhinolaryngology), South Hall A
- 10:00 Surgical Film Exhibition (General), Little Theatre
- 11:00 Panel Discussions
  - Ophthalmology, South Hall B
  - Otorhinolaryngology, South Hall C
- 1:30 Adjourned Meeting, Governors, Music Hall
- 1:45 Annual Meeting, Fellows, Music Hall
- 2:00 Clinics, Demonstrations and Group Conferences, Selected local hospitals
- 2:00 Hospital Conference, Club Room B
- 3:00 Panel Discussion—Graduate Training in Surgery, Ballroom
- 3:30 Panel Discussion, Music Hall
- 3:30 Surgical Film Exhibition (General), Little Theatre
- 4:00 Committee on the Library, Club Room A
- 7:00 Surgical Film Exhibition (Ophthalmology, and Otorhinolaryngology), South Hall A
- 8:00 Symposium, General Surgery, Music Hall
- 8:00 Symposium, Ophthalmology, South Hall B
- 8:00 Symposium, Otorhinolaryngology, South Hall C

## Friday

- 8:00 Clinics, Demonstrations and Group Conferences, Selected local hospitals
- 9:00 Forum on Fundamental Surgical Problems, Section A, Music Hall; Section B, Ballroom
- 9:30 Surgical Film Exhibition (Ophthalmology and Otorhinolaryngology), South Hall A
- 10:00 Surgical Film Exhibition (General), Little Theatre
- 1:00 Assembly of Initiates, Ballroom
- 1:30 Panel Discussion, Surgery of the Stomach, Music Hall
- 2:00 Clinics, Demonstrations and Group Conferences, Selected local hospitals
- 2:00 Panel Discussions
  - Obstetrics, South Hall A
  - Plastic Surgery, Club Room C
  - Neurological Surgery, Club Room A
  - Thoracic Surgery, South Hall B
  - Urology, South Hall C
  - Orthopedic Surgery, Club Room B
- 2:00 Surgical Film Exhibition (General), Little Theatre
- 3:30 Panel Discussion, Surgery of the Vascular System, Music Hall
- 8:15 Convocation, Music Hall



## GENERAL ASSEMBLY

*Monday, 9:30 a.m.—Music Hall, Public Auditorium*

Opening Session of Clinical Congress—General Assembly

W. EDWARD GALLIE, M.D., Toronto; President, American College of Surgeons, Presiding

Preliminary Statement. W. EDWARD GALLIE, M.D., Toronto.

Presentation of Report of Field Activities of the American College of Surgeons for 1946, and Summary of 28 Years of Hospital Standardization.

IRVIN ABELL, M.D., Louisville; Chairman, Board of Regents, American College of Surgeons.

Maintaining our Voluntary Hospital System. Right Reverend Monsignor MAURICE F. GRIFFIN, Cleveland

Pertinent Findings from the National Survey by the Commission on Hospital Care.

ARTHUR C. BACHMEYER, M.D., Chicago; Director of Study, Commission on Hospital Care; Director, University of Chicago Clinics.

The Nursing Problem:

The Viewpoint of the Surgeon.

HOWARD C. NAFFZIGER, M.D., San Francisco; Professor of Surgery, University of California Medical School; Chairman, Committee on Nursing, American Surgical Association.

The Viewpoint of the Administrator.

ROBIN C. BUERKI, M.D., Philadelphia; Director, University Hospitals and Dean of the Graduate School of Medicine, University of Pennsylvania.

The Viewpoint of the Nurse.

LUCILE PETRY, R.N., Washington; Chief of the Division of Nursing, United States Public Health Service.

## PRESIDENTIAL MEETING

*Monday, 8:15 p.m.—Music Hall, Public Auditorium*

W. EDWARD GALLIE, M.D., Toronto; President, American College of Surgeons, Presiding.

Processional—Officers, Regents and Distinguished Guests.

Invocation.

Rev. BEVERLEY D. TUCKER, D.D., LL.D., Cleveland; Bishop of the Diocese of Ohio.

Address of Welcome.

THOMAS E. JONES, M.D., Cleveland; Chairman, Committee on Arrangements.

Introduction of Distinguished Guests.

ARTHUR W. ALLEN, M.D., Boston; Vice Chairman, Board of Regents.

Address of the Retiring President. Ideals in Surgery.

W. EDWARD GALLIE, M.D., Toronto.

Inauguration of Officers Presented by ALBERT G. FURSTENBERG, M.D., Ann Arbor; Second Vice President.

President: IRVIN ABELL, M.D., Louisville.

First Vice President: LELAND S. MCKITTRICK, M.D., Boston.

Second Vice President: F. PHINIZY CALHOUN, M.D., Atlanta.

The Martin Memorial Lecture. The American Surgeon, A.U.S.

EDWARD D. CHURCHILL, M.D., Boston. John Homans Professor of Surgery, Harvard University.

Recessional.

## CONVOCATION

*Friday, 8:15 p.m.—Music Hall, Public Auditorium*

IRVIN ABELL, M.D., Louisville; President, Presiding.

Processional. Initiates, Officers, Regents and Distinguished Guests.

Invocation.

Right Reverend Monsignor MAURICE F. GRIFFIN, Cleveland.

Conferring of Fellowships by the President.

IRVIN ABELL, M.D., Louisville.

Fellowship Pledge. Recital by the Initiates.

Conferring of Honorary Fellowships. The President.

Fellowship Address. The Education of a Physician.

REUBEN G. GUSTAVSON, Ph.D., Omaha; Chancellor, University of Nebraska.

Recessional.

Reception by the Officers and Regents for the Initiates and Fellows.



## OTORHINOLARYNGOLOGY

## Symposia

*Tuesday, 8:00 p.m.—South Hall C, Public Auditorium*

CARL H. McCASKEY, M.D., Indianapolis; Member, Advisory Council for Otorhinolaryngology, American College of Surgeons, Presiding.

*Treatment of Deafness*

The Management of the Chronic Suppurating Ear. JAMES H. MAXWELL, M.D., Ann Arbor.

The Fenestration Operation. GEORGE E. SHAMBAUGH, JR., M.D., Chicago.

The Use of Radium for Conductive Deafness. JOHN E. BORDLEY, M.D., Baltimore.

*Thursday, 8:00 p.m.—South Hall C, Public Auditorium*

DAVID H. BALLON, M.D., Montreal; Chairman of the Department of Otolaryngology, McGill University Faculty of Medicine, Presiding.

*Surgery of the Nasal Accessory Sinuses*

Indications for Surgery in the Light of the Use of Antibiotics. HARRY P. SCHENK, M.D., Philadelphia.

Intranasal Surgery. JOHN J. SHEA, M.D., Memphis.

External Operation. FRANCIS L. WEILLE, M.D., Boston.

## PLASTIC SURGERY OF THE HEAD AND NECK

*Wednesday, 8:00 p.m.—Club Room B, Public Auditorium*

## Symposium

GORDON B. NEW, M.D., Rochester, Minnesota; Member Advisory Council for Otorhinolaryngology, American College of Surgeons, Presiding.

Cancellous Bone Grafts to the Jaw. TRUMAN G. BLOCKER, M.D., Galveston.

Repair of Nasal Defects with Free Composite Grafts of Skin and Cartilage from the Ear. JAMES B. BROWN, M.D., St. Louis, and Lt. Col. BRADFORD CANNON, M.C., Valley Forge.

Studies in the Anatomy and the Repair of Cleft Palate. GEORGE M. DORRANCE, M.D., Philadelphia.

Preservation of Function Following Resections of Jaw Tumors. LOUIS T. BYARS, M.D., St. Louis, and FRANK McDOWELL, M.D., St. Louis.

## SYMPOSIUM ON FRACTURES AND OTHER TRAUMAS

## ADVANCES FROM WAR EXPERIENCE

*Tuesday, 2:00 p.m.—Ballroom, Public Auditorium*

ROBERT H. KENNEDY, M.D., New York; Chairman, Committee on Fractures and Other Traumas, Presiding

Shock and Hemorrhage. CHARLES S. RIFE, M.D., Milwaukee.

Burns. Captain H. L. PUGH, M.C., U. S. Navy, Bethesda.

Injuries to the Chest. EARLE B. KAY, M.D., Cleveland.

Injuries to the Genitourinary Tract: Emphasis on Urethral Injuries. GEORGE C. PRATHER, M.D., Boston.

Injuries to the Rectum. EDMUND J. CROCE, M.D., Worcester.

Herniated Nucleus Pulposus. WINCHELL MCK. CRAIG, M.D., Rochester.

Spinal Cord Injuries. DAVID H. POER, M.D., Atlanta.

Peripheral Nerves. BENJAMIN B. WHITCOMB, M.D., Hartford.

Hand Surgery. WILLIAM H. FRACKELTON, M.D., Milwaukee.

Fractures of the Carpal Scaphoids. MATHER CLEVELAND, M.D., New York.

Transportation of Fractures. WILLIAM J. STEWART, M.D., Columbia.

Management of Compound Fractures in Their Early Phases. OSCAR P. HAMPTON, JR., M.D., St. Louis.

Osteomyelitis following Compound Fractures. GROVER C. PENBERTHY, M.D., Detroit.

Replacement of Skin Defects. JAMES B. BROWN, M.D., St. Louis.

Paravertebral Block and Sympathectomy. HARRIS B. SHUMACKER, JR., M.D., New Haven.

Bone Grafts. GEORGE K. CARPENTER, M.D., Nashville.

Amputations. RUFUS H. ALDREDGE, M.D., New Orleans.

Training of Amputees. HENRY H. KESSLER, M.D., Newark.

Rehabilitation. LT. COL. A. WILLIAM REGGIO, Washington, D.C.

Brief Summary:

MAJOR GENERAL PAUL R. HAWLEY (Ret.), Washington; Chief Medical Director, U.S. Veterans Administration.

VICE ADMIRAL ROSS T. MCINTIRE, Washington; The Surgeon General of the Navy.

MAJOR GENERAL NORMAN T. KIRK, Washington; The Surgeon General of the Army.

## SYMPOSIUM ON CANCER

*Wednesday, 2:00 p.m.—Ballroom, Public Auditorium*

FRANK E. ADAIR, M.D., New York; Chairman, Cancer Committee, American College of Surgeons, Presiding  
Surgical Treatment of Cancer of the Pancreas. RICHARD B. CATTELL, M.D., Boston.

Resections of Abdominal Cancer Infiltrating the Abdominal Wall. ALEXANDER BRUNSWIG, M.D., Chicago.

Hormone Therapy in Cancer of the Prostate. WILLIAM W. SCOTT, M.D., Baltimore.

Estrogen Therapy in Cancer of the Breast. IRA T. NATHANSON, M.D., Boston.

Testosterone in Cancer of the Breast. FRANK E. ADAIR, M.D., New York.

Observations on the Genetic Nature of Gastric Cancer in Mice. LEONELL C. STRONG, Ph.D., New Haven.

## GRADUATE TRAINING IN SURGERY AND THE SURGICAL SPECIALTIES

### PANEL DISCUSSION

*Thursday, 3:00 p.m.—Ballroom, Public Auditorium*

*Graduate Training in Surgery and the Surgical Specialties*

Moderator: ROBIN C. BUECKI, M.D., Philadelphia

The American College of Surgeons

MAJOR GENERAL CHARLES R. REYNOLDS (Ret.), Chicago

The Basic Medical Sciences

GEORGE H. MILLER, M.D., Chicago

The Veterans Administration

PAUL B. MAGNUSON, M.D., Washington

The University-Connected Hospital

JOHN R. PAINE, M.D., Minneapolis

The Hospital Not University-Connected

GEORGE J. CURRY, M.D., Flint

## PANEL DISCUSSIONS

### GENERAL SURGERY

*Monday, 1:30-3:00 p.m.—Music Hall, Public Auditorium*

*Rehabilitation of the Surgical Patient and Early Ambulation*

Moderator: HOWARD RUSK, M.D., New York

Collaborators: I. S. RAYDIN, M.D., Philadelphia

HENRY H. KESSLER, M.D., Newark

JOHN H. POWERS, M.D., Cooperstown

*Monday, 3:30-5:00 p.m.—Music Hall, Public Auditorium*

*The Treatment of Cancer of the Large Bowel*

Moderator: FREDERICK A. COLLIER, M.D., Ann Arbor

Collaborators: THOMAS E. JONES, M.D., Cleveland

CLAUDE F. DIXON, M.D., Rochester, Minnesota

FRED W. RANKIN, M.D., Lexington

*Tuesday, 1:30-3:00 p.m.—Music Hall, Public Auditorium*

*Thiouracil in Thyroid Disease*

Moderator: FRANK LAHEY, M.D., Boston

Collaborators: GEORGE M. CURTIS, M.D., Columbus

WARREN H. COLE, M.D., Chicago

EIMER C. HARTTIS, M.D., Boston

*Tuesday, 3:30-5:00 p.m.—Music Hall, Public Auditorium*

*Recent Trends in the Management of Carcinoma of the Cervix*

Moderator: JOE V. MEIGS, M.D., Boston

Collaborators: RICHARD W. TELINDE, M.D., Baltimore

CHARLES A. BEHNEY, M.D., Philadelphia

RICHARD DRESSER, M.D., Boston

*Wednesday, 1:30-3:00 p.m.—Music Hall, Public Auditorium*

*Anesthesia*

Moderator: HENRY K. BEECHER, M.D., Boston

Collaborators: URBAN H. EVERSOLE, M.D., Boston

LLOYD H. MOUSEL, M.D., Rochester, Minnesota

STUART C. CULLEN, M.D., Iowa City

*Wednesday, 3:30-5:00 p.m.—Music Hall, Public Auditorium*

*Protein Metabolism in the Surgical Patient*

Moderator: ROBERT ELMAN, M.D., St. Louis

Collaborators: CHARLES C. LUND, M.D., Boston

PAUL R. CANNON, M.D., Chicago

JOHN H. MULHOLLAND, M.D., New York

*Thursday, 3:30-5:00 p.m.—Music Hall, Public Auditorium*

*Spinal Cord Injuries*

Moderator: HOWARD C. NAFFZIGER, M.D., San Francisco

Collaborators: FRANCIS C. GRANT, M.D., Philadelphia

ROBERT H. KENNEDY, M.D., New York

LEWIS J. POLLOCK, M.D., Chicago

*Friday, 1:30-3:00 p.m.—Music Hall, Public Auditorium*

*Surgery of the Stomach*

Moderator: ROSCOE R. GRAHAM, M.D., Toronto

Collaborators: G. GAVIN MILLER, M.D., Montreal

LESTER R. DRAGSTEDT, M.D., Chicago

HOWARD K. GRAY, M.D., Rochester, Minnesota

*Friday, 3:30-5:00 p.m.—Music Hall, Public Auditorium*

*Surgery of the Vascular System*

Moderator: DANIEL C. ELKIN, M.D., Atlanta

Collaborators: ALFRED BLALOCK, M.D., Baltimore

ARTHUR H. BLAKEMORE, M.D., New York

MICHAEL E. DEBAKEY, M.D., New Orleans

## SURGICAL SPECIALTIES

### Urology

*Friday, 2:00-5:00 p.m.—South Hall C, Public Auditorium*

*Management of Spinal Cord Bladders*

Moderator: HERMAN L. KRETSCHMER, M.D., Chicago

Collaborators: MICHAEL K. O'HEEREN, M.D., Houston. From the Standpoint of the Urologist

PHILIP LEWIN, M.D., Chicago. From the Standpoint of the Orthopedist

FRANK H. MAYFIELD, M.D., Cincinnati. From the Standpoint of the Neurologist

FRANK H. KRUSEN, M.D., Rochester, Minnesota. From the Standpoint of the Physical Therapist

*Cancer of the Bladder—An Appraisal of Present Day Methods of Treatment*

Moderator: HERMAN L. KRETSCHMER, M.D., Chicago

Collaborators: GERSHOM J. THOMPSON, M.D., Rochester, Minnesota. Conservative Transurethral Treatment of Bladder Tumors

F. H. SQUIRE, M.D., Chicago. Radiation Treatment

CHARLES C. HIGGINS, M.D., Cleveland. Cystectomy with Transplantation of the Ureters to the Bowel or Skin

*Neurological Surgery*

Friday, 2:00—5:00 p.m.—Club Room A, Public Auditorium

*Ruptured Intervertebral Discs*

Moderator: FRANCIS C. GRANT, M.D., Philadelphia

Collaborators: WILLIAM P. VANWAGENEN, M.D., Rochester, New York

RUDOLPH JAEGER, M.D., Philadelphia

JAMES L. POPPEN, M.D., Boston

*Orthopedic Surgery*

Friday, 2:00—5:00 p.m.—Club Room B, Public Auditorium

*Intra-Articular Fractures of the Elbow in Childhood and Adult Life*

Moderator: CARL E. BADGLEY, M.D., Ann Arbor

Collaborators: PHILIP D. WILSON, M.D., New York

HAROLD B. BOYD, M.D., Memphis

CLAY R. MURRAY, M.D., New York

*The Treatment of Club Foot and Its Complications*

Moderator: CARL E. BADGLEY, M.D., Ann Arbor

Collaborators: JOSEPH H. KITE, M.D., Atlanta

FRANK R. OBER, M.D., Boston

FRANK E. CURTIS, M.D., Detroit

*Plastic Surgery*

Friday, 2:00—5:00 p.m.—Club Room C, Public Auditorium

*Early Skin Grafting of Burns*

Moderator: ROBERT H. IVY, M.D., Philadelphia

Collaborators: JEROME P. WEBSTER, M.D., New York

HARVEY S. ALLEN, M.D., Chicago

*Use of Flaps and Grafts in Reconstructive Surgery of the Extremities*

Moderator: ROBERT H. IVY, M.D., Philadelphia

Collaborators: Major CARL E. LISCHER, M.C., Valley Forge

Major WILLIAM B. DAVIS, M.C., Valley Forge

*Obstetrics*

Friday, 2:00—5:00 p.m.—South Hall A, Public Auditorium

*Common Problems of the Obstetrician and Pediatrician in Neonatal Morbidity*

Moderator: THADDEUS L. MONTGOMERY, M.D., Philadelphia

Collaborators: FREDERICK H. FALLS, M.D., Chicago

WALDO E. NELSON, M.D., Philadelphia

*Uterine Inertia*

Moderator: THADDEUS L. MONTGOMERY, M.D., Philadelphia

Collaborators: DOUGLAS P. MURPHY, M.D., Philadelphia

FREDERICK H. FALLS, M.D., Chicago

*Thoracic Surgery**Friday, 2:00-5:00 p.m.—South Hall B, Public Auditorium**Treatment of Carcinoma of the Esophagus**Lung Resection in Pulmonary Tuberculosis*

Moderator: RICHARD H. SWEET, M.D., Boston

Collaborators: JOHN M. GARLOCK, M.D., New York

WILLIAM E. ADAMS, M.D., Chicago

HERBERT C. MAIER, M.D., New York

## OPHTHALMOLOGY

*Tuesday, 11:00 a.m.—South Hall B, Public Auditorium**Retinal Detachment*

Moderator: PAUL A. CHANDLER, M.D., Boston

Collaborators: DONALD W. BOGART, M.D., New York

PETER C. KRONFELD, M.D., Chicago

A. D. RUEDEMANN, M.D., Cleveland

*Wednesday, 11:00 a.m.—South Hall B, Public Auditorium**Glaucoma*

Moderator: SAMUEL J. MEYER, M.D., Chicago

Collaborators: H. SAUL SUGAR, M.D., Chicago

THOMAS D. ALLEN, M.D., Chicago

*Thursday, 11:00 a.m.—South Hall B, Public Auditorium**Keratoplasty*

Moderator: R. TOWNLEY PATON, M.D., New York

Collaborators: DERRICK T. VAIL, JR., M.D., Chicago

HERBERT M. KATZIN, M.D., New York

J. WESLEY MCKINNEY, M.D., Memphis

## OTORHINOLARYNGOLOGY

*Tuesday, 11:00 a.m.—South Hall C, Public Auditorium**The Treatment of Ménière's Disease*

Moderator: ALBERT C. FURSTENBERG, M.D., Ann Arbor

Collaborators: KENNETH M. DAY, M.D., Pittsburgh

JOHN R. LINDSAY, M.D., Chicago

THEODORE E. WALSH, M.D., St. Louis

*Wednesday, 11:00 a.m.—South Hall C, Public Auditorium**Osteomyelitis of the Skull*

Moderator: JOSEPH E. J. KING, M.D., New York

Collaborators: ALBERT C. FURSTENBERG, M.D., Ann Arbor

EDGAR F. FINCHER, M.D., Atlanta

*Thursday, 11:00 a.m.—South Hall C, Public Auditorium**Rehabilitation of the War Deafened*

Moderator: NORTON CANFIELD, M.D., New Haven

Collaborators: FRANCIS L. LEDERER, M.D., Chicago

RAYMOND CARHART, Ph.D., Evanston

HERBERT KOEPP-BAKER, Ph.D., Chicago

CHARLES E. KINNEY, M.D., Cleveland

PRELIMINARY PROGRAM—1946 CLINICAL CONGRESS

FORUM ON FUNDAMENTAL SURGICAL PROBLEMS

*Tuesday, 9:00 a. m.—Music Hall, Public Auditorium*

WARREN H. COLE, M.D., Chicago, Presiding.  
*Intestines and Thyroid*

Effect of Early Postoperative Rising on the Recurrence Rate of Hernia. JAMES B. BLODGETT, M.D., and EDWARD J. BEATTIE, M.D., Boston. Department of Surgery, Harvard Medical School—Peter Bent Brigham Hospital.

The Relation of Transverse Abdominal Incisions and Early Ambulation to the Reduction of Postoperative Complications. KENNETH F. MACLEAN, M.D., and JAMES THOMPSON, M.D., Ann Arbor. Department of Surgery, University of Michigan Medical School.

A New Method for the Roentgenologic Study of the Rectum. GEORGE LEVENE, M.D., Boston. Surgical Service, Massachusetts Memorial Hospitals, and Department of Surgery, Boston University School of Medicine.

Statistical Analysis—Carcinoma of the Colon. WILLIAM J. VYNALEK, M.D., Berwyn, Illinois. Department of Surgery, Veterans Administration Hospital, Hines; and Department of Surgery, Loyola University School of Medicine.

Reconstruction of the Colon and Rectum Following Battle Wounds. DAVID HENRY POER, M.D., Atlanta. Emory University School of Medicine.

Experiences with the Dragstedt Ileostomy. GEORGE BENTON SANDERS, M.D., Louisville. Surgical Service, Vaughan General Hospital, Hines, Illinois; and Department of Surgery, University of Louisville School of Medicine.

The Role of Infection in Experimental Closed Loop Small Bowel Obstruction. EARLE B. MAHONEY, M.D., JOHN A. SCHILLING, M.D., HARRY D. KINGSLEY, M.D., and WALTER A. GUNKLER, M.D., Rochester, New York. Strong Memorial Hospital.

The Effect of Penicillin in Experimental Intestinal Obstruction. ALEXANDER BLAIN, III, M.D., Ann Arbor. Department of Surgery, University Hospital.

Infections of Intestinal Origin. HENRY L. SILVANI, M.D., SANFORD ROTHENBERG, M.D., HELEN WARMER, JOYCE AMLUXEN, and H. J. McCORKLE, M.D., San Francisco. Department of Experimental Laboratory and Clinical Experiences with the Use of Streptomycin in the Prophylaxis and Treatment of Surgery, University of California Medical School.

Thiouracil and Surgical Treatment of Hyperthyroidism. JOHN C. SCULLY, M.D., Chicago. Department of Surgery, Northwestern University Medical School.

Thiouracil and Iodine: The Preoperative Management of the Thyrotoxic Patient. BENJAMIN GOLDMAN, M.D., JAMES WEAVER, M.D., and E. M. RALSTON, M.D., Erie, Pennsylvania. Hamot Hospital.

The Necessity for and Methods of Remedying the Disturbances of Calcium and Phosphorus Metabolism in Patients with Toxic Goiter. I. DARIN PUPPEL, M.D., Columbus, Ohio. Department of Research Surgery, Ohio State University College of Medicine.

*Tuesday, 9:00 a.m.—Ballroom, Public Auditorium*

FREDERICK A. COLLIER, M.D., Ann Arbor, Presiding.  
*Vascular Surgery*

Wounds of Common Carotid Arteries. KNOWLES B. LAWRENCE, M.D., Brookline. Surgical Service, Massachusetts Memorial Hospitals; and Department of Surgery, Boston University School of Medicine.

Ligation of the Inferior Vena Cava in Thrombosis of the Deep Veins of the Lower Extremities. J. ROSS VEAL, M.D., Washington, D.C. Georgetown University School of Medicine.

Ligation of the Inferior Vena Cava. WILLIAM R. MOSES, M.D., Washington, D.C. Department of Surgery, George Washington University School of Medicine; and Gallinger Municipal Hospital.



- Permanent Intubation Anastomosis of the Thoracic Aorta. CHARLES A. HUFNAGEI, M.D., Boston. Department of Surgery, Harvard Medical School—Peter Bent Brigham Hospital.
- The Indications for Porta-caval Anastomosis. ARTHUR H. BLAKEMORE, M.D., New York. Department of Surgery, Columbia University College of Physicians and Surgeons.
- Abdominal Arteriography. Report of Complete Aortic Block. FREDERICK B. WAGNER, JR., M.D., and ALISON H. PRICE, M.D., Philadelphia. Samuel D. Gross Surgical Division and Medical Department, Jefferson Medical College Hospital.
- Frostbite: Functional and Morphologic Pathology and the Prevention of Subsequent Gangrene. KURT LANGE, M.D., DAVID WEINER, M.D., and LINN J. BOYD, M.D., New York. New York Medical College, Flower and Fifth Avenue Hospitals.
- The Right Heart Catheterization Technique as Applied to the Investigation of Arteriovenous Fistulas. A Case Study. B. W. HAYNES, JR., M.D., I. A. BIGGER, M.D., and EVERETT IDRIS EVANS, M.D., Richmond. Department of Surgery, Medical College of Virginia.
- Sympathectomy as an Adjunct in Surgery of Aneurysms and Arteriovenous Fistulas. HARRIS B. SHUMACKER, JR., M.D., New Haven. New Haven Hospital.
- The Use of Prolonged Continuous Spinal Anesthesia to Relieve Vasospasm and Pain in Peripheral Embolism. SCOTT M. SMITH, M.D., and VINCENT L. REES, M.D., Salt Lake City. University of Utah School of Medicine.
- Femoral Vein Ligation for Chronic Occlusive Arterial Disease. S. THOMAS GLASSER, M.D., New York. New York Medical College, Flower and Fifth Avenue Hospitals.
- The Effects of Altered Blood Flow in Venous Vasa Vasorum upon the Condition of Venous Endothelium, and the Relation of Anoxia of Vein Walls to Intravenous Thrombosis. JAMES F. O'NEILL, M.D., Boston. Department of Physiology, Harvard University School of Public Health.

*Wednesday, 9:00 a.m.—Music Hall, Public Auditorium*

MICHAEL L. MASON, M.D., Chicago, Presiding.

### *Wound Healing and Infection*

- Experiments with Non-irritating Glove Powder. C. MARSHALL LEE, JR., M.D., Charlottesville. Department of Surgery and Gynecology, University of Virginia Department of Medicine.
- Magnesiogenous Pneumagranuloma as a Research Tool. CARL W. WALTER, M.D., Boston. Department of Surgery, Harvard Medical School—Peter Bent Brigham Hospital.
- Human Hemoglobin as a Vehicle. LIEUTENANT COLONEL FELIX JANSEY, M.C., A.U.S., Hines. Orthopedic Service, Veterans Administration Hospital, and Department of Surgery, Northwestern University Medical School.
- Rate of Gain in Strength in Sutured Abdominal Wounds. CLARENCE DENNIS, M.D., JOHN EAST, M.D., and CARLETON NELSON, M.D., Minneapolis. Department of Surgery, University of Minnesota Medical School.
- Clostridial Myositis. F. A. SIMEONE, M.D., Boston. Department of Surgery, Harvard Medical School—Massachusetts General Hospital.
- Results Following the Pigment Injection (Tattooing) of Port Wine Stains and Skin Grafts. HERBERT CONWAY, M.D., New York. New York Hospital.
- A New Operative Treatment of Elephantiasis. EDGAR J. POTH, M.D., and SAM R. BARNES, M.D., Galveston. University of Texas Medical Branch.
- Observations on the Volume of the Blood in Patients with Weight Loss. JOHN H. CLARK, M.D., New Orleans. Department of Surgery, Tulane University of Louisiana School of Medicine.
- The Estimation of Acute Blood Loss by the Tilt Test. DANIEL GREEN, M.D., and DAVID METHENY, M.D., Seattle. King County Hospital.
- Tissue Destruction in the Immediate Postoperative Period. ROBERT L. BERRY, M.D., VIVIAN JOE, Ph.D., and KENNETH N. CAMPBELL, M.D., Ann Arbor. Department of Surgery, University of Michigan Medical School.

The Diagnosis and Treatment of Fat Embolism. J. E. DUNPHY, M.D., FREDERICK ILFELD, M.D., and MAGNUS SMEDAL, M.D., Boston. Department of Surgery, Harvard Medical School—Peter Bent Brigham Hospital.

*Wednesday, 9:00 a.m.—Ballroom, Public Auditorium*

ALEXANDER BRUNSCHWIG, M.D., Chicago, Presiding.

*Liver, Gallbladder, and Pancreas*

Intermittent External Biliary Drainage for Relief of Pruritus in Certain Chronic Disorders of the Liver. RICHARD L. VARCO, M.D., Minneapolis. Department of Surgery, University of Minnesota Medical School.

Visualization of Amebic Abscess of the Liver as an Aid to Therapy and Prognosis. HARRY C. HULL, M.D., Baltimore. University of Maryland School of Medicine and College of Physicians and Surgeons.

Experimental Implantations of the Common Bile Duct. TED BINKLEY, M.D., ROBERT PALMER, M.D., and H. J. MCCORKLE, M.D., San Francisco. Department of Experimental Surgery, University of California Medical School.

The Effect of Anemic Anoxia (Hemorrhage) and Anoxic Anoxia on Hepatic Function in Dogs. H. A. DAVIS, M.D., Los Angeles. Department of Surgery, College of Medical Evangelists.

Principles Involved in Surgical Therapy of "Encapsulated" Connective Tissue Malignancies. WALTER W. CARROLL, M.D., Chicago. Department of Surgery, Northwestern University Medical School.

Acute Pancreatitis and Its Sequelae. THOMAS J. ANGLE, M.D., Boston. Surgical Service, Massachusetts Memorial Hospitals; and Department of Surgery, Boston University School of Medicine.

Acute Pancreatitis: An Experimental Study with Special Reference to X-ray Therapy. TAGUE C. CHISHOLM, M.D., Minneapolis, and ROY E. SEIBEL, M.D., Boston. Department of Surgery, Harvard Medical School—Peter Bent Brigham Hospital.

Radical Pancreatoduodenectomy with Resection of the Patent Portal Vein. PAUL W. SCHAFER, M.D., Kansas City, Kansas. Department of Surgery, University of Kansas School of Medicine.

Pancreatic Reflux Deliberately Produced. HENRY DOUBILET, M.D., New York. New York University College of Medicine.

Care of the Dog with External Pancreatic Fistula. FRED KOLOUCH, M.D., Minneapolis. Department of Surgery, University of Minnesota Medical School.

*Thursday, 9:00 a.m.—Music Hall, Public Auditorium*

OWEN H. WANGENSTEEN, M.D., Minneapolis, Presiding.

*Gastric Surgery*

Carcinoma of the Stomach. CLAUDE E. WELCH, M.D., Boston. Department of Surgery, Harvard Medical School—Massachusetts General Hospital.

An Experimental Study of Motility of the Stomach after Vagotomy. RAYMOND W. POSTLETHWAIT, M.D., Durham, North Carolina. Department of Surgery, Duke University School of Medicine.

The Effect of Supradiaphragmatic Vagus Nerve Section in Man. WALTER B. CRANDELL, M.D., WALTER E. BOEHM, M.D., and JOHN H. MULHOLLAND, M.D., New York. New York University College of Medicine.

Complications Observed after Transthoracic Vagotomy for Peptic Ulcer. KEITH S. GRIMSON, M.D., Durham. Department of Surgery, Duke University School of Medicine.

The Condition of Eight Patients Fifteen Months or More After Total Gastrectomy. WILLIAM P. LONGMIRE, JR., M.D., Baltimore. Johns Hopkins University School of Medicine.

Use of Buffered Thrombin in Control of Gastric Hemorrhage. BYRNE M. DALY, M.D., Detroit. Departments of Surgery and Physiology, Wayne University College of Medicine.

The Sippy Regimen Protects Against the Histamine-provoked Ulcer. JOHN FAST, M.D., Minneapolis. Department of Surgery, University of Minnesota Medical School.

- Abetting Influence of Hemoconcentration on Ulcer Diathesis. IVAN D. BARONOFFSKY, M.D., Minneapolis. Department of Surgery, University of Minnesota Medical School.
- Autodigestion and Repair in the Normal and Hyperacid Canine Stomach. PHILIP B. PRICE, M.D., Salt Lake City. Department of Surgery, University of Utah School of Medicine.
- Experimental Burns Abet the Ulcer Diathesis. STANLEY R. FRIESEN, M.D., Minneapolis. Department of Surgery, University of Minnesota Medical School.
- A New Simplified Intestinal Decompression Tube. MEYER O. CANTOR, M. D., Detroit. Grace Hospital.

*Thursday, 9:00 a.m.—Ballroom, Public Auditorium*

HOWARD C. NAFFZIGER, M.D., San Francisco, Presiding.

*Neurosurgery and Sympathectomy*

- The Use of Penicillin in Conjunction with Bone Grafting in Experimental Skull Defects. H. J. MCCORMIE, M.D., EDWIN KERR, M.D., SANFORD ROTHENBERG, M.D., and HELEN WARNER, San Francisco. Department of Experimental Surgery, University of California Medical School.
- The Localization of Intracranial Tumors by Electroencephalography. R. C. BASSETT, M.D., and B. K. BACCHI, Ph.D., Ann Arbor. University of Michigan Medical School.
- Decerebration in the Traumatized Human: Its Pathogenesis and Management. RUSSELL MEYERS, M.D., Iowa City. State University of Iowa College of Medicine.
- The Incidence of Interhemispheric Extension of Glioblastoma Multiforme Through the Corpus Callosum. HARRY P. MAXWELL, M.D., Milwaukee. Department of Surgery, Marquette University School of Medicine.
- After-image Perimetry. WILLIAM P. WILLIAMSON, M.D., Kansas City, Kansas. University of Kansas School of Medicine.
- Blockade of the Autonomic Ganglia by Tetra-ethyl Ammonium Bromide in Peripheral Vascular Disease and Causalgic States. KENNETH N. CAMPBELL, M.D., ROBERT L. BERRY, M.D., MARTIN R. SUTLER, M.D., RICHARD H. LYONS, M.D., and GORDON K. MOE, M.D., Ann Arbor. Department of Surgery, University of Michigan Medical School.
- The Effect of Autonomic Blockade on the Urinary Bladder in Man. JACK LAPIDES, M.D., REED M. NESBITT, M.D., WILLIAM L. VALK, M.D., MARTIN R. SUTLER, M.D., ROBERT L. BERRY, M.D., RICHARD H. LYONS, M.D., KENNETH N. CAMPBELL, M.D., and GORDON K. MOE, M.D., Ann Arbor. Department of Surgery, University of Michigan Medical School.
- Lumbar Ganglionectomy in Occlusive Peripheral Vascular Disease. GEORGE H. YEAGER, M.D., Baltimore. University of Maryland School of Medicine and College of Physicians and Surgeons.
- Testing Hypertensive Patients Preoperatively. JAMES L. SOUTHWORTH, M.D., Baltimore and HENRY I. RUSSEK, M.D., Staten Island. Surgical Service, United States Marine Hospital, Baltimore, and Cardiovascular Research Unit, United States Marine Hospital, Staten Island.
- The Operative and Postoperative Management of Hypertensive Patients Undergoing Thoracolumbar Sympathectomy. JERE W. LORD, JR., M.D., and J. WILLIAM HINTON, M.D., New York. Sympathectomy Clinic, New York Post-Graduate Medical School and Hospital.

*Friday, 9:00 a.m.—Music Hall, Public Auditorium*

GROVER C. PENBERTHY, M.D., Detroit, Presiding.

*Extremities, Bones and Joints, Burns, and Gynecology.*

- The Present Concepts Concerning the Care of the Burned Patient. WILLIAM E. ABBOTT, M.D., Detroit, and John Winslow Hirshfeld, M.D., Ithaca, New York. Harper Hospital, Detroit.
- The Physiological Approach to the Local Treatment of Burns. EDWARD L. HOWES, M.D., and WOLFGANG ACKERMANN, M.D., New York. Columbia University College of Physicians and Surgeons.
- Hypocholesterolemia of the Adrenal Glands in Experimental Burns. HENRY N. HARKINS, M.D., Baltimore. Johns Hopkins University School of Medicine.

- Disadvantages and Dangers of Refrigeration Anesthesia. KENNETH PEACOCK, M.D., and GIUSEPPE D'ANDREA, M.D., New York. New York Medical College, Flower and Fifth Avenue Hospitals.
- The Problem of Pain in Amputation Stumps. LOUIS G. HERRMANN, M.D., Cincinnati. University of Cincinnati College of Medicine.
- Immobilization of the Injured Hand in Position of Function. HARVEY S. ALLEN, M.D., Chicago. Department of Surgery, Northwestern University Medical School.
- Experimental Study of Internal Fixation of Fractures. WILLIAM H. AINSWORTH, M.D., Galveston. Department of Surgery, University of Texas Medical Branch.
- Acromioclavicular Separation. A Study of the End Results Obtained with the Screw Method of Repair. BOARDMAN M. BOSWORTH, M.D., New York. New York Hospital.
- Musculotendinous Tears of the Shoulder Joint. GEORGE E. WILSON, M.B., Toronto. University of Toronto Faculty of Medicine and St. Michael's Hospital.
- Diagnosis of Precancer of the Cervix by Cytology. J. ERNEST AYRE, M.D., Montreal. Gynecology Laboratory, Royal Victoria Hospital; and McGill University Faculty of Medicine.
- Modification in Technique of the Manchester Operation for Uterine Prolapse. RALPH E. CAMPBELL, M.D., Madison. University of Wisconsin Medical School.
- Extraperitoneal Iliac Lymphadenectomy in the Treatment of Cancer of the Cervix. IRA T. NATHANSON, M.D., Boston. Harvard Medical School—Massachusetts General Hospital, Tumor Clinic, Boston; and Pondville Hospital, Walpole.
- Endometriosis of the Gastrointestinal Tract. MARTIN R. SUTLER, M.D., Ann Arbor. Departments of Pathology and Surgery, University of Michigan Medical School.

*Friday, 9:00 a.m.—Ballroom, Public Auditorium*

CLAUDE S. BECK, M.D., Cleveland, Presiding.

*Thorax, Breast, Heart, and Anesthesia*

- Treatment of Chronic Non-tuberculous Pulmonary Abscesses. HARRY E. NELSON, M.D., Dallas. Southwestern Medical College of the Southwestern Medical Foundation.
- Surgical Treatment of Bullous Emphysema. JEROME R. HEAD, M.D., Chicago. Department of Surgery, Northwestern University Medical School.
- Anomalies of the Pulmonary Vein. O. C. BRANTIGAN, M.D., Baltimore. University of Maryland School of Medicine and College of Physicians and Surgeons.
- Physiological Studies in Congenital Heart Disease. RICHARD J. BING, M.D., and L. D. VANDAM, M.D., Baltimore. Department of Surgery, Johns Hopkins University School of Medicine.
- Experimental Aortic Valvulotomy: A Preliminary Report. H. G. SMITHY, M.D., and EDWARD F. PARKER, M.D., Charleston, South Carolina. Department of Surgery, Medical College of the State of South Carolina.
- Indications for Simple Mastectomy. DANIEL P. SLAUGHTER, M.D., and LAWRENCE W. PETERSON, M.D., Chicago. Tumor Clinic, Research and Educational Hospitals, University of Illinois College of Medicine.
- A Clinical-Experimental Study of the Uptake of Radioactivated Phosphorus by Tumors of the Breast. B. V. A. LOW-BEER, M.D., H. GLENN BELL, M.D., H. J. McCORKLE, M.D., and ROBERT S. STONE, M.D., with the assistance of W. B. HILL, M.D., and H. L. STEINBACH, M.D., San Francisco. Divisions of Radiology and Surgery, University of California Medical School.
- A New Type of Endobronchial Airway. C. P. BAILEY, M.D., and HENRY S. RUTH, M.D., Philadelphia. Departments of Surgery and Anesthesiology, Hahnemann Medical College and Hospital of Philadelphia.

# TWENTY-FIFTH ANNUAL HOSPITAL STANDARDIZATION CONFERENCE

*Monday, 9:30 a.m.—Music Hall,  
Public Auditorium*

- Opening Session of Clinical Congress—General Assembly  
W. EDWARD GALLIE, M.D., Toronto; President, American College of Surgeons, Presiding  
Greetings from the American Hospital Association  
JOHN H. HAYES, New York; President  
Greetings from the Canadian Hospital Council  
HARVEY AGNEW, M.D., Toronto; Secretary  
Preliminary Statement. W. EDWARD GALLIE, M.D., Toronto.  
Presentation of Report of Field Activities of the American College of Surgeons for 1946, and Summary of 28 Years of Hospital Standardization.  
IRVIN ANELL, M.D., Louisville; Chairman, Board of Regents, American College of Surgeons.  
Maintaining our Voluntary Hospital System  
RIGHT REVEREND MONSIGNOR MAURICE T. GRIFFIN, Cleveland  
Pertinent Findings from the National Survey by the Commission on Hospital Care.  
ARTHUR C. BACHMEYER, M.D., Chicago, Director of Study, Commission on Hospital Care, Director, University of Chicago Clinics.  
The Nursing Problem.  
The Viewpoint of the Surgeon  
HOWARD C. NAFZIGER, M.D., San Francisco; Professor of Surgery, University of California Medical School; Chairman, Committee on Nursing, American Surgical Association.  
The Viewpoint of the Administrator.  
ROBIN C. BULKEI, M.D., Philadelphia; Director, University Hospitals and Dean of the Graduate School of Medicine, University of Pennsylvania.  
The Viewpoint of the Nurse.  
LUCILE PETRY, R.N., Washington, Chief of the Division of Nursing, United States Public Health Service.

*Monday, 2:00 p.m.—Ballroom, Public Auditorium*

- Panel Discussion on Current Problems and Immediate Future Outlook in Nursing Service.*  
Conducted by JOHN H. HAYES, New York; President, American Hospital Association, Superintendent, Lenox Hill Hospital.  
The Future of Nursing  
JAMES W. STEPHAN, Canton, Ohio; Director, Aultman Hospital.  
Nursing Standards as Affected by Personnel Policies.  
EDGAR BLAKE, JR., Chicago; Superintendent, Wesley Memorial Hospital  
Postwar Student Nurse Recruitment Problems.  
EDITH H. SMITH, Syracuse; Dean of the School of Nursing, Syracuse University.  
The Training of a Secondary Group for Nursing Service.  
H. LENORE BRADLEY, Albany; Supervisor of Nursing Education, New York Board of Nurse Examiners.  
Round Table Conference on Nursing Problems.  
Moderator: JAMES W. STEPHAN, Canton.  
Collaborators:  
PAUL H. FISLER, Oklahoma City; Administrator, University of Oklahoma Hospitals.

- LOIS HOLIMAN, R.N., Chicago; Associate Director, Cook County School of Nursing.  
CELA CRANZ, R.N., Akron; Director of Nursing, City Hospital of Akron.  
LFE S. LANPHER, Cleveland; Administrator, Lutheran Hospital.  
HARVEY AGNEW, M.D., Toronto; Secretary, Canadian Hospital Council.

*Tuesday, 9:30 a.m.—Club Room B,  
Public Auditorium*

- Panel Discussion—The Securing of Complete and Scientific Medical Records.*  
Conducted by EVERETT W. JONES, Chicago; Vice-President, The Modern Hospital Publishing Company.  
Introductory Remarks by the Chairman—Status of Medical Records in Hospitals as I Have Observed Them  
The Program of the American Association of Medical Record Librarians to Improve Medical Record Science  
LONA K. HUFFMAN, Chicago; Chief Medical Record Librarian, Wesley Memorial Hospital; Director, Program in Medical Record Library Science, Northwestern University.  
The Importance of Complete and Scientific Medical Records from the Standpoints of:  
Better Care of the Patient.  
GILSON C. ENGEL, M.D., Philadelphia; Associate Professor of Surgery, University of Pennsylvania Graduate School of Medicine.  
Self Education of the Practicing Physician.  
JOHN R. ORNDORFF, M.D., Chicago; Clinical Assistant in Surgery, Northwestern University Medical School  
Education and Training of Interns and Residents  
FRODE JENSEN, M.D., Chicago; Council on Medical Education and Hospitals, American Medical Association  
Advancement of Medical Science.  
BRIGADIER-GENERAL WALLACE H. GRAHAM, Washington; Physician to the President of the United States

- Round Table Conference. The Problems Relating to the Obtaining of Complete and Scientific Medical Records*  
Moderator: EVERETT W. JONES, Chicago.  
Collaborators—(In addition to Panel participants)  
FRANK C. SUTTON, M.D., Rochester; Assistant Medical Director, Rochester General Hospital  
WILLIAM B. SELTZER, Cleveland; Superintendent, Mount Sinai Hospital.  
L. J. CROZIER, M.D., London; Superintendent, Victoria Hospital.  
GUY W. DRUGLER, M.D., Cleveland; Assistant Director, University Hospitals.  
HELEN L. POTTS, R.N., Woodstock, Ontario; Administrator, Woodstock General Hospital.

*Tuesday, 2:00 p.m.—Club Room B,  
Public Auditorium*

- Panel Discussion: Extending General Hospital Service to all Types of Patients.*  
HERMAN SMITH, M.D., Chicago; Hospital Consultant; President  
Trends in the Care of Psychiatric Patients.  
LLOYD M. LYONS, Chicago; Director, St. Luke's Hospital.

**Trends in the Care of Tuberculous Patients.**

HERMAN E. HILLEBOE, M.D., Washington; Medical Director, Tuberculosis Control Division, United States Public Health Service.

**Trends in the Care of Chronically Ill Patients.**

EDNA S. NICHOLSON, Chicago; Director, Central Service for the Chronically Ill.

**Trends in the Care of Orthopedic Patients.**

EDWARD L. COMPERE, Chicago; Associate Professor of Surgery, Rush Medical School.

**Integration of Health Services in the Community.**

GRAHAM L. DAVIS, Battle Creek; Hospital Director, W. K. Kellogg Foundation; President-Elect, American Hospital Association.

**General Discussion—Question and Answer Period.**

Led by HARVEY AGNEW, M.D., Toronto; Secretary, Canadian Hospital Council.

*Tuesday, 7:30 p.m.—Little Theatre,  
Public Auditorium*

**Hospital Motion Picture**

Joint Session for Hospital Trustees, Medical Staff Officers and Administrators.

FRED G. CARTER, M.D., Cleveland; Administrator, St. Luke's Hospital, Presiding.

**The Governing Board of the Hospital.**

RAYMOND W. SLOAN, New York; Editor, The Modern Hospital.

**The Education of the Hospital Trustee.**

ROBERT F. BINGHAM, Cleveland; President, Board of Trustees, St. Luke's Hospital; Chairman, Board of Trustees, Cleveland Hospital Council.

**Minimum Qualifications to Practice Major Surgery.**

FRANK S. GIBSON, M.D., Cleveland; Senior Clinical Instructor in Surgery, Western Reserve University School of Medicine.

**Cooperation Between Blue Cross and Medical Service Plans.**

ROLLO K. PACKARD, M.D., Chicago; Chairman, Board of Trustees, Woodlawn Hospital; Member, Board of Trustees, Blue Cross Plan for Hospital Care of Chicago.

**Development of Training for Surgery.**

CHARLES A. BOWERS, M.D., Cleveland; Head, Department of Urology, St. Luke's Hospital.

*Wednesday, 7:45 a.m.—Lattice Room,  
Hotel Statler*

**Breakfast—Joint Conference on Hospital Public Relations.**

Hospital personnel and press and radio representatives Conducted by GUY J. CLARK, Cleveland; Secretary, Cleveland Hospital Council.

**Discussion of "The Hospital in the News"**

*Wednesday, 9:30 a.m.—Club Room B,  
Public Auditorium*

**Panel Discussion—The Responsibility of the Administrative Staff in Handling Emergencies Coming to the Hospital and Occurring Within.**

Conducted by FRANK R. BRADLEY, M.D., St. Louis; Director, Barnes Hospital; President, American College of Hospital Administrators.

**Transportation of the Injured and Other Types of Emergency Patients.**

CHARLES W. MYERS, M.D., Indianapolis; Superintendent, Indianapolis City Hospital.

**The Essentials of an Efficient Emergency Service in the Hospital.**

FREDERICK A. RETTIG, M.D., Chicago; Chief of Staff, Alexian Brothers Hospital; Instructor, Loyola University School of Medicine.

**Preparedness of the Hospital to Cope with Acute Emergencies:****Postoperative Hemorrhage in Tonsillectomy.**

CARL H. MCCASKEY, M.D., Indianapolis; Professor of Otolaryngology and Chairman of Department, Indiana University School of Medicine.

**Acute Respiratory Obstruction Requiring Emergency Intubation or Emergency Tracheotomy.**

HORACE E. MITCHELL, M.D., Cleveland; Clinical Instructor of Otolaryngology, Western Reserve University School of Medicine; Chief of Department of Otolaryngology and Peroral Endoscopy, Lakewood City Hospital.

**Sudden Collapse on Operating Table.**

ROBERT L. SANDERS, M.D., Memphis; Associate Professor of Surgery, University of Tennessee College of Medicine; Head of the Surgical Section, Sanders Clinic.

**Ante- and Post partum Hemorrhage.**

RALPH E. CAMPBELL, M.D., Madison; Associate Professor of Obstetrics and Gynecology, University of Wisconsin Medical School.

**Emergencies Arising During the Administration of Anesthesia.**

RALPH T. KNIGHT, M.D., Minneapolis; Associate Professor of Surgery, University of Minnesota Medical School, Director, Division of Anesthesiology, University of Minnesota Hospitals.

*Wednesday, 2:00 p.m.—Club Room B,  
Public Auditorium*

**Panel Discussion on the Training of Hospital Personnel.**

Conducted by CLAUDE W. MUNGER, M.D., New York; Director, St. Luke's Hospital; Director, Division of Hospital Administration, Columbia University. University Training for Hospital Administration.

MALCOLM T. MACEACHERN, M.D., Chicago; Associate Director, American College of Surgeons; Director of Program in Hospital Administration, Northwestern University.

**Establishing Administrative Internships or Residencies on a High Educational Level.**

GILBERT HARTMAN, Ph.D., Iowa City; Superintendent, University of Iowa Hospitals.

**Training Supervisory Personnel.**

WARREN R. VON EHREN, Hines, Illinois; Chief, Utilization and Training Section, Veterans Administration Hospital.

**Training Personnel Managers.**

JANE F. CARLISLE, Cleveland; Personnel Director, St. Luke's Hospital.

**Round Table Conference on Training Programs for Professional and Non-Professional Personnel.**

Moderator: CHARLES E. PRALL, Ph.D., Chicago, Director, Joint Commission on Education.

**Collaborators:**

JOHN GORRELL, M.D., New York; Associate Director Hospital Administration, Columbia University School of Public Health.

JAMES W. STEPHAN, Canton; Associate Director, Division of Hospital Administration, University of Minnesota.

FRANK R. BRADLEY, M.D., St. Louis; Director, Barnes Hospital; President, American College of Hospital Administrators; Director, Division of Hospital Administration, Washington University.

LAURA G. JACKSON, Chicago; Director of Public Relations, American College of Surgeons; Associate Director, Program in Hospital Administration, Northwestern University.

MIRIAM CURTIS, R.N., Syracuse; Administrator, Syracuse Memorial Hospital.

LEO M. LYONS, Chicago; Director, St. Luke's Hospital.

NELLIE GORGAS, Minneapolis; Superintendent, St. Barnabas Hospital.

*Wednesday, 7:30 p.m.—Little Theatre,  
Public Auditorium*

*Round Table Conference on Current Hospital Problems.*

Moderator: EVERETT W. JONES, Chicago; Vice-President, The Modern Hospital Publishing Company, and MALCOLM T. MACEachern, M.D., Chicago; Associate Director, American College of Surgeons.

*Collaborators:*

O. K. FIKE, Dayton; Director, Miami Valley Hospital.  
MERRILL F. STEELE, M.D., Cincinnati; Superintendent, Christ Hospital.

HENRY H. HOOPER, Cincinnati; Superintendent, Cincinnati General Hospital.

HELEN L. POTTS, R.N., Woodstock, Ontario; Superintendent, Woodstock General Hospital.

LEO M. LYONS, Chicago; Director, St. Luke's Hospital.

H. M. COON, M.D., Madison; Superintendent, State of Wisconsin General Hospital.

JOHN A. McNAMARA, Cleveland; Director, Cleveland Hospital Service Association.

ROGER W. DEBUSK, M.D., Evanston; Executive Director, Evanston Hospital.

*Thursday, 7:45 a.m.—Lattice Room,  
Hotel Statler*

*Breakfast Conference.*

*The Point Rating System as Applied to Hospitals.*

MALCOLM T. MACEachern, M.D., Chicago; Associate Director, American College of Surgeons, Presiding.

*Collaborators:*

HARVEY AGNEW, M.D., Toronto; Secretary, Canadian Hospital Council.

HENRY G. FARISH, M.D., Chicago; American College of Surgeons.

*Thursday, 9:30 a.m.—Club Room B,  
Public Auditorium*

*Panel Discussion on Management Techniques and Personnel Relations.*

Conducted by JAMES A. HAMILTON, Minneapolis; Director, Program in Hospital Administration, University of Minnesota; Hospital Consultant.

*Development of Management Skills as a Factor in Hospital Progress.*

JAMES A. HAMILTON  
Employment Policies; Incentives; Job Classification; Health Program.

*Training Manual for Hospital Employees, Cleveland Hospital Council.*

GUY J. CLARK, Cleveland; Executive Secretary, The Cleveland Hospital Council.

*Round Table Conference—Questions and Answers.*

*Thursday, 2:00 p.m.—Club Room B,  
Public Auditorium*

*Small Hospital Session—Special Problems of the Small Hospital.*

ELIZABETH JANE DAVIS, Niles, Michigan; Superintendent, Pawating Hospital, Presiding.

*The Application of the Standard Nomenclature in the Small Hospital (Illustrated).*

EDNA K. HUFFMAN, R.R.L., Chicago; Chief Medical Record Librarian, Wesley Memorial Hospital; Director, Program in Medical Record Library Science, Northwestern University.

*Cooperative Relationships between the Small Hospital and the Metropolitan or Large Hospital.*

ANDREW PATTULLO, Battle Creek; Associate Director, Hospital Division, Kellogg Foundation.

*The Organization of the Medical Staff of the Small Hospital.*  
R. R. CRAWFORD, M.D., Lakewood, Ohio; Superintendent, Lakewood Hospital.

*Personnel Management in the Small Hospital.*

MERTON E. KNISELY, Milwaukee; Superintendent, St. Luke's Hospital.

*Thursday, 3:00 p.m.—Ballroom,  
Public Auditorium*

*Graduate Training in Surgery and the Surgical Specialist.*

Moderator: ROBIN C. BUERKI, M.D., Philadelphia; Director, University Hospitals and Dean of the Graduate School of Medicine, University of Pennsylvania.

*Panel Discussion from the standpoints of:*

*The American College of Surgeons.*

MAJOR GENERAL CHARLES R. REYNOLDS (Ret.), Chicago  
Director, Department of Graduate Training in Surgery, American College of Surgeons.

*The Basic Medical Sciences.*

GEORGE H. MILLER, M.D., Chicago; Educational Director, American College of Surgeons.

*The Veterans Administration.*

PAUL B. MAGNUSON, M.D., Washington; Acting Assistant Medical Director for Research and Education, Veterans Administration.

*The University-Connected Hospital.*

JOHN R. PAINE, M.D., Minneapolis; Associate Professor of Surgery, University of Minnesota Medical School

*The Hospital not University-Connected.*

GEORGE J. CURRY, M.D., Flint, Michigan; Director of Traumatic and Orthopedic Surgery, Hurley Hospital

## ASSEMBLY OF INITIATES

*Friday, 1:00 p.m.—Ballroom, Public Auditorium*

IRVIN ABELL, M.D., Louisville; President, Presiding.

Opening Remarks—General Organization of the College. IRVIN ABELL, M.D., Louisville.

The Program of the American College of Surgeons:

Hospital Standardization; Sectional Meetings; Medical Motion Pictures; Library and Literary Research.

MALCOLM T. MACEachern, M.D., Chicago; Associate Director and Chairman of the Administrative Board.

Graduate Training in Surgery.

MAJOR GENERAL CHARLES R. REYNOLDS (Ret.), Chicago; Director, Department of Graduate Training in Surgery.

Credentials Department; Clinical Research.

BOWMAN C. CROWELL, M.D., Chicago; Associate Director and Vice Chairman of the Administrative Board.

Fellowship in the American College of Surgeons.

ARTHUR W. ALLEN, M.D., Boston; Vice President, Board of Regents.

The Fellowship Pledge. Recital by Initiates.

## ANNUAL MEETING, BOARD OF GOVERNORS OF THE AMERICAN COLLEGE OF SURGEONS

*Wednesday, 12:00 Noon—Lattice Room, Hotel Statler*

IRVIN ABELL, M.D., Louisville; President, Presiding.

Statement by the Chairman of the Board of Regents. IRVIN ABELL, M.D.

Brief Reports on the Activities, Problems and Progress of the American College of Surgeons.

BOWMAN C. CROWELL, M.D., Chicago; Associate Director and Vice Chairman of the Administrative Board.

MALCOLM T. MACEachern, M.D., Chicago; Associate Director and Chairman of the Administrative Board.

DALLAS B. PHEMISTER, M.D., Chicago; Treasurer.

FREDERICK A. COLLIER, M.D., Ann Arbor; Regent.

PAUL B. MAGNUSON, M.D., Chicago; Secretary.

Discussion by Governors and Regents.

## ADJOURNED MEETING, BOARD OF GOVERNORS

*Thursday, 1:30 p.m.—Music Hall, Public Auditorium*

IRVIN ABELL, M.D., Louisville; Chairman of the Board of Regents, Presiding.

Report of Committee on Nominations to the Board of Governors.

## ANNUAL MEETING, FELLOWS OF THE AMERICAN COLLEGE OF SURGEONS

*Thursday, 1:45 p.m.—Music Hall, Public Auditorium*

IRVIN ABELL, M.D., Louisville; President, Presiding.

Report of Committee on Nominations to the Fellows.

Election of Officers.

Financial Report. DALLAS B. PHEMISTER, M.D., Chicago; Treasurer.

Report of Administrative Board. MALCOLM T. MACEachern, M.D., Chicago; Associate Director and Chairman of the Administrative Board.

Departmental Reports.

a. Hospital Standardization. b. Sectional Meetings. MALCOLM T. MACEachern, M.D., Chicago.

Graduate Training in Surgery. MAJOR GENERAL CHARLES R. REYNOLDS (Ret.), Chicago; Director, Department of Graduate Training in Surgery.



Credentials Department—Credentials Committees; Committees on Applicants; and Committee on History Reviews; Clinical Research. **BOWMAN C. CROWELL, M.D.**, Chicago; Associate Director. Medical Motion Pictures; Publications. **ELEANOR K. GRIMM**, Chicago; Administrative Executive. Library and Literary Research. **J. MARGUERITE PRIME**, Chicago; Director of Library and Literary Research.

Public Relations. **LAURA G. JACKSON**, Chicago; Director of Public Relations.

Committee on Cancer. **FRANK E. ADAIR, M.D.**, New York; Chairman.

Committee on Fractures and Other Traumas. **ROBERT H. KENNEDY, M.D.**, New York; Chairman.

Committee on Graduate Training in Surgery. **DALLAS B. PHEMISTER, M.D.**, Chicago; Chairman.

Fellowship Obligations and Opportunities.

**ARTHUR W. ALLEN, M.D.**, Boston; Regent and Vice Chairman, Board of Regents.

Closing Remarks. The American College of Surgeons and Postwar Progress.

**IRVIN ABELL, M.D.**, Louisville; Chairman, Board of Regents.

## COMMITTEE MEETINGS

**IRVIN ABELL, M.D.**, Louisville, Chairman, Board of Regents, Presiding.

### STATE AND PROVINCIAL EXECUTIVE COMMITTEES

*Wednesday, 9:30 a.m.—Ballroom, Hotel Statler*

Statement by the Chairman of the Board of Regents. **IRVIN ABELL, M.D.**, Louisville.

Report on Sectional Meetings held in 1946 and Plans for Meetings in 1947.

**MALCOLM T. MACEACHERN, M.D.**, Chicago.

Comments on Sectional Meetings, 1946-1947, in behalf of the Committees on Local Arrangements.

**FRASER B. GURD, M.D.**, Montreal; **CHARLES S. KENNEDY, M.D.**, Detroit; **JAMES M. HAYES, M.D.**, Minneapolis; **HUGH TOLAND JONES, M.D.**, Los Angeles.

Discussion by the Fellows and Regents.

### STATE AND PROVINCIAL CREDENTIALS COMMITTEES AND COMMITTEES ON APPLICANTS

*Wednesday, 10:15 a.m.—Ballroom, Hotel Statler*

Statement by the Chairman of the Board of Regents. **IRVIN ABELL, M.D.**, Louisville.

Report of Work of Credentials Committees and Committees on Applicants, 1946.

**BOWMAN C. CROWELL, M.D.**, Chicago; Associate Director.

Interesting Observations in Interviewing Prospective Candidates.

**H. PRATHER SAUNDERS, M.D.**, Chicago; Assistant Director.

The Junior Candidate.

**MAJOR GENERAL CHARLES R. REYNOLDS (Ret.)**, Chicago; Director, Department of Graduate Training in Surgery.

Discussion by the Fellows and Regents.

### STATE AND PROVINCIAL JUDICIARY COMMITTEES

*Wednesday, 11:00 a.m.—Ballroom, Hotel Statler*

Statement by the Chairman of the Board of Regents. **IRVIN ABELL, M.D.**, Louisville.

Selection and Appointment of Judiciary Committees and Procedure in Dealing with Judiciary Cases.

**BOWMAN C. CROWELL, M.D.**, Chicago; Associate Director.

Types of Cases Referred to the Judiciary Committees.

**MALCOLM T. MACEACHERN, M.D.**, Chicago; Associate Director.

Discussion by Regents and Fellows of the College.

## PRELIMINARY CLINICAL PROGRAM

## CLEVELAND CITY HOSPITAL

## Tuesday

## General Surgery

- S. O. FREEDLANDER, D. M. GLOVER, W. C. MCCALLY, M. B. TALIAK, J. H. LAZZARI, C. A. HAMANN, R. J. MCNAMEE, M. H. LAMBRIGHT, J. S. GELLER, A. M. LEIGH.  
9:00 a.m.—Operative clinic.

## Tumor Surgery

- L. A. POMEROY, S. O. FREEDLANDER, H. H. HAUSER, J. H. LAZZARI, A. E. BENNETT, and staff.  
2:00 p.m.—Tumor clinic. Case presentations for diagnosis and treatment.

## Pathology

- H. T. KARSNER, H. G. SCHLUMBERGER, R. C. TAYLOR, and staff.  
2:00 p.m.—Clinical pathological conference.

## Fractures and other traumas

- F. M. BARRY, D. DIAL, and staff.  
2:00 p.m.—Fracture service; ward rounds; discussions of treatment and results.

## Thoracic Surgery

- S. O. FREEDLANDER, R. C. MCKAY, M. C. PERLICH, C. W. MUNZ, D. B. KAY, and staff.  
2:00 p.m.—Group conference. Selection of cases for thoracoplasty, lobectomy, and pneumonectomy.

## Wednesday

## General Surgery

- S. O. FREEDLANDER, D. M. GLOVER, W. C. MCCALLY, M. B. TALIAK, J. H. LAZZARI, C. A. HAMANN, R. J. MCNAMEE, M. H. LAMBRIGHT, J. S. GELLER, A. M. LEIGH.  
9:00 a.m.—Operative clinic.  
2:00 p.m.—Nonoperative clinic:  
M. H. LAMBRIGHT. The acute abdomen in patients carrying artificial pneumoperitoneum.  
J. S. GELLER. Acute obstructive cholecystitis.  
A. M. LEIGH. Esophageal diverticula.  
W. C. MCCALLY. Vagus nerve resection for peptic ulcer.  
J. H. LAZZARI. Hemipelvectomy for sarcoma of femur.

## Plastic Surgery

- D. M. GLOVER and C. A. HAMANN.  
9:00 a.m.—Operative clinic.  
2:00 p.m.—Nonoperative clinic; case presentations—problems and management of skin flaps. Lantern slides.

## Otolaryngology

- C. W. ENGLER, W. F. HULSE, S. E. MISSAL, CRAMER and Associates.  
9:00 a.m.—Operative clinic.  
2:00 p.m.—Nonoperative clinic; demonstration of oral and laryngeal malignancies.

## Thursday

## Neurosurgery

- C. S. BECK, C. W. ELKINS, and associates.  
9:00 a.m.—Operative clinic.  
2:00 p.m.—Nonoperative clinic.  
2:00 p.m.—C. W. ELKINS—Acrylic plastics in skull defects.

## Vascular Surgery

- L. A. ATLAS and associates.  
9:00 a.m.—Operative clinic; lumbar sympathectomy; saphenous vein ligations.  
2:00 p.m.—Nonoperative clinic; demonstration of venograms; indications for femoral vein ligations.

## Genitourinary Surgery

- H. R. TRATTNER, A. ROTH, and associates.  
9:00 a.m.—Operative clinic.

## General Surgery

- R. W. SCOTT, S. O. FREEDLANDER, M. H. LAMBRIGHT, E. CHESTER, D. M. GLOVER, M. B. TALIAK, A. M. MARSHALL, J. H. LAZZARI, H. HOELSCHER, A. S. BROGLIO.  
2:00 p.m.—Nonoperative clinic; lesions of stomach and intestine; pancreatic lithiasis with steatorrhea.

## Friday

## Thoracic Surgery

- S. O. FREEDLANDER, D. B. KAY, C. W. MUNZ, and associates.  
9:00 a.m.—Operative clinic: pneumonectomy, lobectomy, thoracoplasty.  
2:00 p.m.—Nonoperative clinic.  
2:00 p.m.—Motion pictures: esophagectomy, pneumonectomy, lobectomy.

## Orthopedic Surgery

- L. M. STARIN, A. TRAMER, P. H. DUBAY, and associates.  
9:00 a.m.—Operative clinic: Spinal fusion.  
9:00 a.m.—Nonoperative clinic.

## Gynecology

- J. L. REYCRAFT, A. L. BENNETT, E. RICHARDS, and associates.  
9:00 a.m.—Operative clinic: Plastics; vaginal hysterectomy; Watkin's interposition.

## Radiology

- HARRY HAUSER and associates.  
9:00 a.m.—A. R. COHEN—Roentgen diagnosis of lesions of small intestine.  
10:00 a.m.—H. HAUSER—Roentgen diagnosis of thoracic tumors.  
11:00 a.m.—B. BROWN—Differential roentgen diagnosis of mechanical and adynamic ileus.

## CLEVELAND CLINIC

## Tuesday

## General Surgery

- T. E. JONES and GEORGE CRILE, JR.  
8:00 a.m.—Operative surgery and demonstration of cases.
- R. L. HADEN, L. W. DIGGS, D. W. BORTZ and R. S. DINSMORE.  
9:00 a.m.—Symposium—spleen: General considerations; platelets in hemorrhagic disease; presentation of cases; surgical aspects.
- IRVINE H. PAGE, Leader; A. C. CORCORAN, ROBERT D. TAYLOR and W. JAMES GARDNER.  
11:00 a.m.—Symposium—hypertension: General considerations; selection of cases for surgery; surgical aspects.

## Genitourinary Surgery

- CHARLES C. HIGGINS.  
8:00 a.m.—Operative clinic.

## Ophthalmology

- A. D. RUEDEMANN.  
8:00 a.m.—Operative clinic.

## Orthopedic Surgery

- JAMES A. DICKSON and J. I. KENDRICK.  
8:30 a.m.—Operative clinic.

## Otolaryngology

- PAUL M. MOORE, JR.  
10:00 a.m.—Operative clinic.
- H. E. HARRIS.  
1:00 p.m.—Operative clinic.

## Pathology

- JOHN B. HAZARD.  
10:00 a.m.—Surgical pathological conference.
- JOHN B. HAZARD.  
11:45 a.m.—Demonstration of surgical pathological specimens.

## Neurosurgery

- W. JAMES GARDNER, A. T. BUNTS, and W. A. NOSIK.  
1:00 p.m.—Operative clinic.

## Wednesday

## General Surgery

- T. E. JONES.  
8:00 a.m.—Operative clinic.
- GEORGE CRILE, JR., Leader; E. N. COLLINS, JOHN F. RENSHAW, J. C. ROOT, and HAROLD R. ROSSMILLER.  
9:00 a.m.—Symposium: Upper stomach and pancreas.
- R. S. DINSMORE.  
1:30 p.m.—Operative clinic.

## Genitourinary Surgery

- CHARLES C. HIGGINS.  
8:00 a.m.—Operative clinic.
- W. E. LOWER, CHARLES C. HIGGINS, W. J. ENGEL.  
10:00 a.m.—Genitourinary clinic: Presentation of cases and discussion.
- T. E. JONES and associates.  
11:00 a.m.—Clinic: Diseases of colon.

## Ophthalmology

- A. D. RUEDEMANN and R. J. KENNEDY.  
8:00 a.m.—Demonstration of cases.

## Otolaryngology

- PAUL M. MOORE, JR.  
10:00 a.m.—Operative clinic and demonstration of cases.

## Pathology

- JOHN B. HAZARD.  
11:45 a.m.—Demonstration of surgical pathological specimens.

## Neurosurgery

- W. JAMES GARDNER, A. T. BUNTS and W. A. NOSIK.  
1:00 p.m.—Operative clinics.

## Thursday

## General Surgery

- T. E. JONES and GEORGE CRILE, JR.  
8:00 a.m.—Operative clinics.
- IRVINE H. PAGE, Leader; A. C. CORCORAN, ROBERT D. TAYLOR, and W. JAMES GARDNER.  
11:00 a.m.—Symposium—Hypertension: General considerations; selection of cases for surgery; surgical aspects.

## Genitourinary Surgery

- CHARLES C. HIGGINS.  
8:00 a.m.—Operative clinic.
- WILLIAM J. ENGEL.  
1:00 p.m.—Operative clinic and demonstration of cases.

## Ophthalmology

- A. D. RUEDEMANN and R. J. KENNEDY.  
8:00 a.m.—Operative clinic.

## Orthopedic Surgery

- JAMES A. DICKSON and J. I. KENDRICK.  
8:30 a.m.—Operative clinic.
- JAMES A. DICKSON, Leader; J. I. KENDRICK, and DR. PHALEN.  
10:00 a.m.—Clinic—Hip Joint.

## Otolaryngology

- PAUL M. MOORE, JR.  
10:00 a.m.—Operative clinic.
- H. E. HARRIS.  
1:00 p.m.—Operative clinic.

## Pathology

- JOHN B. HAZARD.  
11:45 a.m.—Demonstration of surgical pathological specimens.

## Neurosurgery

- W. JAMES GARDNER, Leader; A. T. BUNTS, W. A. NOSIK, and A. STOWELL.  
9:00 a.m.—Clinic: Presentation of cases and discussion.
- W. JAMES GARDNER, A. T. BUNTS, and W. A. NOSIK.  
1:00 p.m.—Operative clinic.

## Weekly Surgical Staff Conference

- 1:30 p.m.—Staff.

*Friday*

## General Surgery

- T. E. JONES.  
8:00 a.m.—Operative clinics.
- R. S. DINSMORE, E. PERRY McCULLAGH, GEORGE CRILE, Jr., and A. C. ERNSTENE.  
9:00 a.m.—Thyroid clinic: Presentation of cases and discussion.
- DONALD B. HALE, U. V. PORTMANN, and HAROLD E. HARRIS.  
10:00 a.m.—Discussion of special problems: Safeguards in spinal anesthesia; radiation therapy in carcinoma of breast; treatment of esophageal varices.
- IRVINE H. PAGE, Leader; A. C. CORCORAN, OTTO GLASSER, and W. JAMES GARDNER.  
11:00 a.m.—Symposium—Shock: Crush syndrome; intra-arterial transfusions; induced hypotension.
- R. S. DINSMORE.  
1:30 p.m.—Operative clinic.

## Genitourinary Surgery

- CHARLES C. HIGGINS.  
8:00 a.m.—Operative clinic.

## Ophthalmology

- A. D. RUEDEMANN, and R. J. KENNEDY.  
8:00 a.m.—Operative clinic.

## Orthopedic Surgery

- JAMES A. DICKSON, and J. I. KENDRICK.  
8:30 a.m.—Operative clinic.

## Otolaryngology

- PAUL M. MOORE, JR.  
10:00 a.m.—Operative clinic.

## Pathology

- JOHN B. HAZARD.  
11:45 a.m.—Demonstration of surgical pathological specimens.

## Neurosurgery

- W. JAMES GARDNER, A. T. BUNTS, and W. A. NOSIK.  
1:00 p.m.—Operative clinic.

## EVANGELICAL DEACONESS HOSPITAL

*Wednesday*

## General Surgery

- J. R. JOHNSON and associates.  
9:00 a.m.—Operative and nonoperative clinic.

*Thursday*

## General Surgery

- O. A. WEBER and associates.  
9:00 a.m.—Operative and nonoperative clinic.

*Friday*

## General Surgery

- S. C. LIND and associates.  
9:00 a.m.—Operative and nonoperative clinic.

## FAIRVIEW PARK HOSPITAL

*Tuesday*

## General Surgery

- W. E. SMITH and F. H. HEYSE.  
9:00 a.m.—Operative clinic.

## Obstetrics and Gynecology

- E. D. SAUNDERS.  
9:00 a.m.—Operative clinic.

*Wednesday*

## General Surgery

- H. W. MASENHIMER and J. R. KELKER.  
9:00 a.m.—Operative clinic.

## Genitourinary Surgery

- L. F. HUFFMAN.  
9:00 a.m.—Operative clinic.

*Thursday*

## Orthopedic Surgery

- G. I. BAUMAN.  
9:00 a.m.—Operative clinic.

## Roentgenology

- E. V. BAEYER.  
9:00 a.m.—Demonstration of films.

## Obstetrics and Gynecology

- E. D. SAUNDERS.  
2:00 p.m.—Nonoperative clinic.

*Friday*

## General Surgery

- H. W. MASENHIMER, W. E. SMITH, J. R. KELKER, and F. H. J. HEYSE.  
9:00 a.m.—Operative clinic.

## Otolaryngology

- W. H. RIEGER.  
2:00 p.m.—Operative clinic.

## GRACE HOSPITAL

*Tuesday*

## Obstetrics and Gynecology

- PAUL F. HASSE.  
2:00 p.m.—Operative clinic.

## Ophthalmology and Otolaryngology

- H. W. COOPER.  
2:00 p.m.—Operative clinic.

*Wednesday*

## General Surgery

- HARRY C. BARR.  
9:00 a.m.—Operative and nonoperative clinic, rectal.
- A. E. BIDDINGER.  
2:00 p.m.—Operative clinic.

## Orthopedic Surgery

LOUIS M. STARIN and PAUL H. DUBE.  
9:00 a.m.—Operative and nonoperative clinic.

## Otolaryngology

FORREST W. MERICA.  
2:00 p.m.—Nonoperative clinic: Vertigo due to eustachian tube obstruction and its treatment.

## Thursday

## General Surgery

NORTH W. SHUTTER.  
9:00 a.m.—Exhibit of interesting x-ray cases; discussion of radiological problems.  
STANLEY N. F. DEVILLE and G. C. RANKIN.  
9:00 a.m.—Demonstration of technique of spinal anesthesia.

## Otolaryngology

RALPH W. FRACKELTON.  
9:00 a.m.—Operations: Nasal plastic.  
Staff.  
2:00 p.m.—Nonoperative clinic: Peroral endoscopy.

## LUTHERAN HOSPITAL

## Tuesday

## General Surgery

D. S. SPRENG, J. H. LAZZARI, F. A. CATALANO, W. R. HODGES, H. H. ROENICK, E. R. HEXTER.  
9:00 a.m.—Operative clinic.  
J. P. EICHMORN, J. A. GROH, and H. G. SLOAN.  
10:00 a.m.—Nonoperative clinic: Symposium on peptic ulcer: Medical aspects, radiological aspects; surgical aspects.

## Wednesday

## General Surgery

H. G. SLOAN, B. B. LARSEN, V. L. TICHY, J. H. TILDES, E. C. ROY, J. F. HATTENBACH.  
9:00 a.m.—Operative clinic.  
Staff—J. H. LAZZARI, Chairman.  
10:30 a.m.—Tumor clinic—Presentation of current cases

## Thursday

## General Surgery

F. S. GIBSON, J. T. BOHM, G. A. TISCHLER, C. E. WARD, C. F. WARD, CONRAD OTTELIN, C. W. HAHN.  
9:00 a.m.—Operative clinic.  
F. S. GIBSON, FRANCIS BAYLESS, and J. A. GROH.  
10:30 a.m.—Nonoperative clinic: Symposium on diseases of the breast: The clinical diagnosis; pathology of breast tumors, the value of x-ray as a postoperative agent.

## Friday

## General Surgery

S. C. LIND, J. H. LAZZARI, I. J. GOODMAN, B. B. LARSEN, D. S. SPRENG.  
9:00 a.m.—Operative clinic.

## Ophthalmology

W. P. CHAMBERLAIN, JR.  
9:00 a.m.—Operative clinic.

## Genitourinary Surgery

D. A. CHAMBERS and W. E. FORSYTHE.  
9:00 a.m.—Operative clinic.

## THE POLYCLINIC HOSPITAL

## Tuesday

## General Surgery

HENRY A. SCHLINK.  
8:00 a.m.—Operative clinic.  
JOHN R. FLENT.  
10:00 a.m.—Operative clinic.

## Obstetrics and Gynecology

WILLIAM N. MACEY.  
11:00 a.m.—Operative clinic.

## Wednesday

## General Surgery

PAUL M. SPURNEY.  
9:00 a.m.—Operative clinic.  
WILLIAM KUTLER.  
10:00 a.m.—Operative clinic.  
CHARLES J. PROCHASKA.  
11:00 a.m.—Operative clinic.

## Fractures and Other Traumas

S. L. ROBBINS.  
9:00 a.m.—Fracture clinic.

## Genitourinary Surgery

HARRY R. TRATTNER.  
9:00 a.m.—Nonoperative clinic: Prostatectomy.

## Thursday

## General Surgery

JOHN T. VITKUS.  
9:00 a.m.—Operative clinic.  
A. J. KAZLAUCKAS.  
10:00 a.m.—Operative clinic.

## Otolaryngology

A. L. STOTTER.  
9:00 a.m.—Nasal reconstruction.

## Pathology

Nonoperative clinic.  
11:00 a.m.—Clinical pathological conference.

## Friday

Nonoperative clinic.  
9:30 a.m.—Carcinoma, corpus uteri; spontaneous rupture of uterus; intestinal obstruction; ectopic gestation.

## MACDONALD HOUSE—UNIVERSITY HOSPITALS

## Tuesday

## Gynecology and Obstetrics

J. L. REYCRRAFT.  
9:30 a.m.—Gynecology operative clinic.  
W. R. BARNEY.  
11:00 a.m.—Ward rounds.

*Wednesday*

## Gynecology and Obstetrics

- R. L. FAULKNER.  
9:30 a.m.—Symposium: Uterine bleeding.  
L. A. POMEROY.  
11:00 a.m.—Carcinoma cervix.

*Thursday*

## Gynecology and Obstetrics

- R. L. FAULKNER.  
9:30 a.m.—Obstetrics and gynecology pathological conference.  
R. A. SIMPLEY.  
11:00 a.m.—Presentation of gynecological endocrine problems.

## MOUNT SINAI HOSPITAL

*Tuesday*

## Orthopedic Surgery

- RUDOLPH S. REICH, A. MILLER, A. W. TRAMER, S. KLEIN,  
A. H. DRIELS.  
8:00 a.m.—Operative clinic.

## Obstetrics and Gynecology

- JACOB L. BUBIS and staff.  
9:00 a.m.—Nonoperative clinic.

## Oral Surgery

- EDWARD REITER.  
2:00 p.m.—Nonoperative clinic.

## Genitourinary Surgery

- D. SCHNITZER.  
9:00 a.m.—Nonoperative clinic: Traumatic-urological complications of abdominal surgery.  
J. GALVIN.  
9:00 a.m.—Nonoperative clinic: Carcinoma of the ureter.  
A. ROTH.  
9:00 a.m.—Nonoperative clinic: Carcinoma of the kidney.

*Wednesday*

## General Surgery

- S. O. FREEDLANDER, H. M. GANS, H. H. PEVAROFF, DR.  
HOFFMAN, DR. GELLER, DR. BOOKATZ.  
8:00 a.m.—Operative clinic.

## Pathology

- B. J. KLINE and DR. YOUNG.  
2:00 p.m.—Clinical pathology.

## Ophthalmology

- H. M. GANS and staff.  
2:00 p.m.—Nonoperative clinic: Ophthalmological problems illustrated with Kodachrome slides.

## Otorhinolaryngology

- S. S. QUITTNER and S. BAUMOEL.  
9:00 a.m.—Nonoperative clinic: Vertigo.

*Thursday*

## Obstetrics and Gynecology

- JACOB L. BUBIS and staff.  
8:00 a.m.—Operative clinic.

## General Surgery

- S. O. FREEDLANDER and staff.  
9:00 a.m.—Nonoperative clinic.

## Pathology

- B. J. KLINE and DR. YOUNG.  
2:00 p.m.—Pathological conference.

*Friday*

## General Surgery

- S. O. FREEDLANDER and staff.  
8:00 a.m.—Operative clinic.

## Orthopedic Surgery

- RUDOLPH S. REICH and staff.  
9:00 a.m.—Nonoperative clinic: End results of ununited fractures of the femoral neck; fractures of the elbow; fractures of the calcaneus; unreduced Pott's fractures.

## ST. ALEXIS HOSPITAL

*Tuesday*

## General Surgery

- J. F. CORRIGAN, W. F. BOUKALIK, E. F. KIEGER, E. A. MASTICS, F. A. SPITTLER, J. N. WYCHGEL.  
9:00 a.m.—Operative clinic.

## Genitourinary Surgery

- J. A. SOMMER and C. R. NUCKOLLS.  
9:00 a.m.—Operative clinic.

## Neurosurgery

- E. W. SHANNON.  
9:00 a.m.—Operative clinic.

## Ophthalmology

- H. V. PHELAN.  
9:00 a.m.—Operative clinic.  
10:00 a.m.—Demonstration of cases.

## Otolaryngology

- F. W. DIXON and FRED ADELSTEIN.  
9:00 a.m.—Operative clinic.

*Wednesday*

## General Surgery

- J. F. CORRIGAN, W. F. BOUKALIK, E. F. KIEGER, E. A. MASTICS, F. A. SPITTLER, J. N. WYCHGEL.  
9:00 a.m.—Operative clinic.

## Genitourinary Surgery

- J. A. SOMMER and C. R. NUCKOLLS.  
9:00 a.m.—Operative clinic.

## Ophthalmology

- H. V. PHELAN.  
9:00 a.m.—Operative clinic.

*Thursday*

## General Surgery

- J. F. CORRIGAN, W. F. BOUKALIK, E. F. KIEGER, E. A. MASTICS, F. A. SPITTLER, J. N. WYCHGEL.  
9:00 a.m.—Operative clinic.

## Genitourinary Surgery

J. A. SOMMER and C. R. NUCKOLLS.  
9:00 a.m.—Operative clinic.

## Neurosurgery

E. W. SHANNON.  
9:00 a.m.—Operative clinic.

## Ophthalmology

H. V. PRELAN.  
9:00 a.m.—Operative clinic.

## Otolaryngology

F. W. DIXON and FRED ADELSTEIN.  
9:00 a.m.—Operative clinic.

## ST. JOHN'S HOSPITAL

## Tuesday

## General Surgery

J. R. RIFTON.  
9:00 a.m.—Operative clinic: Thyroid surgery.  
J. W. HANNIBAL.  
9:00 a.m.—Operative clinic: Gall-bladder and common duct surgery.  
WILLIAM NOVINE.  
9:00 a.m.—Nonoperative clinic: Discussion of liver function tests.

## Otolaryngology

J. T. COLLINS.  
10:00 a.m.—Operative clinic: Radical antrum.

## Neurosurgery

E. W. SHANNON.  
10:00 a.m.—Operative clinic: Intervertebral disc.

## Wednesday

## General Surgery

J. R. RIFTON.  
9:00 a.m.—Operative clinic: Gall bladder.  
C. E. STEYER.  
11:00 a.m.—Nonoperative clinic: liver and gall bladder.  
WILLIAM E. MISHLER.  
10:00 a.m.—Operative clinic: Hernia.

## Genitourinary Surgery

J. A. SOMMER.  
9:00 a.m.—Operative clinic: Nephrectomy.  
WILLIAM J. MANNING.  
10:00 a.m.—Nonoperative clinic: Indications for suprapubic prostatectomy.

## Roentgenology

DAVID STEEL.  
2:00 p.m.—Tumor clinic.  
H. C. HARTZELL.  
2:00 p.m.—Tumor clinic.

## Thursday

## General Surgery

F. T. GALLAGHER.  
9:00 a.m.—Gastric resection (indications for Billroth No. 1 and Hoffmeister-Balfour resections).  
J. E. HANNIBAL.  
9:00 a.m.—Thyroid surgery.

## Fractures and Other Traumas

R. J. SCHRAFF.  
10:00 a.m.—Intracapsular fracture of neck of femur, Smith-Petersen nail.

## Otolaryngology

F. L. MCGANNON.  
10:00 a.m.—Nonoperative clinic: Hemangioma of uvula.

## Thoracic Surgery

C. W. MUNZ.  
11:00 a.m.—Operative clinic.

## Friday

## General Surgery

J. E. HANNIBAL.  
9:00 a.m.—Carcinoma of the recto-sigmoid, anterior resection.  
F. T. GALLAGHER.  
9:00 a.m.—Combined abdomino-perineal resection.  
R. J. SCHRAFF.  
9:00 a.m.—Nonoperative clinic: Skin graft.  
WILLIAM E. MISHLER.  
11:00 a.m.—Nonoperative clinic: Injury to knee.

## Otolaryngology

DAVID STEEL.  
10:00 a.m.—Radiation in otolaryngology.

## ST. LUKE'S HOSPITAL

## Tuesday

## General Surgery

D. M. GLOVER, R. S. MCGINNIS, and staff.  
9:00 a.m.—Operative clinic.  
B. B. SANKEY and staff.  
9:00 a.m.—Demonstration in anesthesia.

## Thoracic Surgery

EARLE B. KAY.  
9:00 a.m.—Operative clinic.

## Pathology

RAFAEL DOMINGUEZ and staff.  
1:30 p.m.—Surgical pathological conference.

## General Surgical Clinic

ERNEST F. BRIGHT.  
2:30 p.m.—Peripheral vascular clinic.  
R. S. MCGINNIS.  
2:50 p.m.—Early ambulation in relation to postoperative complications.  
HAROLD J. THEISEN.  
3:10 p.m.—Amino acid therapy.  
EDMUND E. BEARD.  
3:20 p.m.—Thiouracil in thyrotoxicosis.  
JOHN A. TOPINKA.  
3:50 p.m.—Work of the tissue committee.  
JOHN H. NICHOLS.  
4:00 p.m.—Psychic disorders simulating surgical conditions.  
D. M. GLOVER.  
4:20 p.m.—Wound management.  
Discussion.  
4:35 p.m.

## Thoracic Surgical Clinic

- EARLE B. KAY.  
2:30 p.m.—Pneumonectomies (motion pictures).  
EARLE B. KAY.  
2:50 p.m.—Esophageal resections for stricture.  
A. D. NICHOLS.  
3:10 p.m.—Follow-up on patent ductus cases from the cardiac clinic.  
Discussion.  
3:40 p.m.

## Wednesday

## General Surgery

- B. B. SANKEY and staff.  
9:00 a.m.—Demonstrations in anesthesia.

## Neurosurgery

- SPENCER BRADEN.  
9:00 a.m.—Operative clinic.  
2:00 p.m.—Neurosurgical clinic:  
SPENCER BRADEN.  
2:00 p.m.—The herniated disc.  
DON D. BRANNAN.  
2:30 p.m.—Myelography.  
F. R. HILL and SPENCER BRADEN.  
2:50 p.m.—Management of head injuries  
JOHN H. NICHOLS.  
3:00 p.m.—The traumatic neurosis.

## Orthopedic and Traumatic Surgery

- T. A. WILLIS and staff.  
9:00 a.m.—Operative clinic.  
3:30 p.m.—Orthopedic and traumatic surgery clinic:  
T. A. WILLIS.  
3:30 p.m.—Management of the fractured hip.  
B. B. LARSEN.  
3:50 p.m.—Fixation of the hip (motion pictures).  
W. H. MCGAW.  
4:10 p.m.—Internal derangements of the knee; pneumograms.  
Discussion.  
4:40 p.m.

## Obstetrics and Gynecology

- C. T. HEMMINGS, G. B. HURD, and staff.  
9:00 a.m.—Operative clinic.  
2:00 p.m.—Obstetrical and gynecological clinic.  
C. T. HEMMINGS.  
2:00 p.m.—Conduct of normal delivery (motion pictures).  
C. T. HEMMINGS.  
2:30 p.m.—Operative obstetrics (motion pictures).  
GERALD B. HURD.  
3:00 p.m.—Management of uterine displacements.

## Tumor Conference

- D. D. BRANNAN and R. DOMINGUEZ.  
3:30 p.m.—Lymphoma.  
L. A. POMEROY.  
3:45 p.m.—Carcinoma of the cervix.  
GERALD B. HURD.  
4:00 p.m.—Carcinoma of the uterine body.  
R. B. HERRICK.  
4:15 p.m.—Bone tumors.  
R. S. MCGINNIS.  
4:30 p.m.—Carcinoma of stomach; carcinoma of colon.  
P. J. ROBECHER.  
4:45 p.m.—Carcinoma of the breast.

## Thursday

## General Surgery

- B. B. SANKEY and staff.  
9:00 a.m.—Demonstrations in anesthesia.  
2:00 p.m.—Clinic on anesthesiology.  
G. R. HAMILTON.  
2:00 p.m.—Supportive therapy in the operating room.  
R. M. CRANT.  
2:20 p.m.—Anesthesia in thyroid surgery.  
L. E. CAMPBELL.  
2:40 p.m.—Clinical aspects of curare.  
B. B. SANKEY.  
3:00 p.m.—Some aspects of spinal anesthesia.

## Plastic and Maxillofacial Surgery

- D. M. GLOVER and D. T. SHAW.  
9:00 a.m.—Operative clinic.  
D. M. GLOVER, D. T. SHAW, C. A. HAMANN, and GAYLORD JAMES, D.D.S.  
3:15 p.m.—Plastic and maxillofacial surgery clinic: operative management of the harelip (motion pictures); Cleft Palate Problems: surgery, speech training, prosthesis; various applications of split thickness grafts; pedicle grafts, hand problems; reconstruction of external ear, temporomandibular ankylosis.

## Orthopedic and Traumatic Surgery

- T. A. WILLIS.  
9:00 a.m.—Orthopedic and traumatic surgical operations.  
WALLACE S. DUNCAN, T. A. WILLIS, W. A. ENGEL, D. M. GLOVER.  
2:00 p.m.—Orthopedic and traumatic surgery clinic: Disabilities of the ankle joint; low back pain; 20 year review of burns.

## Friday

## General Surgery

- B. B. SANKEY and staff.  
9:00 a.m.—Anesthesia demonstrations.  
9:00 a.m.—General surgical clinic.  
P. J. ROBECHER.  
9:00 a.m.—Postoperative complications and deaths.  
R. S. MCGINNIS.  
9:15 a.m.—Intestinal obstruction.  
B. B. LARSEN.  
9:35 a.m.—The pilonidal sinus; operative treatment (motion pictures).  
W. C. FARGO.  
10:00 a.m.—Pyloric stenosis in the infant.  
D. M. GLOVER.  
10:20 a.m.—Anomalies of the intestinal tract in the newborn.  
J. G. JONES.  
10:45 a.m.—Biliary fistula—subphrenic abscess—bronchial fistula.  
Discussion.  
11:00 a.m.

## Genitourinary Surgery

- C. A. BOWERS and staff.  
9:00 a.m.—Urological operations.  
2:00 p.m.—Urological clinic.  
D. A. CHAMBERS.  
2:00 p.m.—Nephrectomy in surgical hypertension.  
H. B. WRIGHT.  
2:30 p.m.—Treatment of vesicovaginal fistula.



## JAMES LYNCH.

3:00 p.m.—Cysts of the kidney.

## D. W. MCINTYRE.

3:30 p.m.—Discussion of renal tumors.

## C. A. BOWERS.

4:00 p.m.—The present status of prostatic surgery.

## Otorhinolaryngology

## THOMAS W. THOBURN and staff

9:00 a.m.—Otorhinolaryngological operations.

2:00 p.m.—Otorhinolaryngological clinic.

## J. W. MCCALL

2:00 p.m.—The esophageal voice in laryngectomized patients.

## C. E. KINNEY.

2:30 p.m.—Results of the fenestration operation.

## F. W. ALI VANDLER

3:00 p.m.—Common errors in rhinoplasty.

## T. W. THOBURN

3:30 p.m.—Management of the nasal septum tip deflection in rhinoplasty

## WARD MILLS

4:00 p.m.—Case of double malignancy of the larynx.

## LEE STONER

4:15 p.m.—Esophageal stricture due to lye ingestion, complicated by peri-esophageal metastases of a supranal tumor.

## Ophthalmology

## M. W. JACOBY and staff.

9:00 a.m.—Ophthalmological clinic.

## PAUL G. MOORE

9:00 a.m.—Traumatic eye surgery; intraocular foreign bodies.

## M. W. JACOBY

9:30 a.m.—Traumatic eye surgery: contusions of globe, intraocular hemorrhage and secondary glaucoma.

## Discussion.

10:00 a.m.

## GERALD T. SCHWARZ and M. I. SPARKS.

10:15 a.m.—The albumin-globulin ratio: its relation to diabetic retinopathy.

## B. J. WOLPAW.

10:45 a.m.—Visual requirements for flying (original study, Naval Flying School, Pensacola).

## Discussion.

11:15 a.m.

## E. F. HARVEY.

11:30 a.m.—Interesting fundus cases: a. Pits of optic nerve; b. Division of optic nerve with extensive field defect; c. Angioid streaks of retina.

## Discussion.

12:00 noon.

## ST. VINCENT CHARITY HOSPITAL

## Tuesday

## Ophthalmology

## H. H. WYAND and associates.

2:00 p.m.—Nonoperative clinic.

## Wednesday

## General Surgery

## O. A. WEBER and associates.

9:00 a.m.—Operative clinic.

## Orthopedic Surgery

## C. G. BARBER and associates.

9:00 a.m.—Operative clinic.

## Thursday

## General Surgery

## Tumor clinic.

8:00 a.m.

## J. E. HALLISY and associates.

9:00 a.m.—Operative clinic.

## Otolaryngology

## C. W. ENGLER and associates.

9:00 a.m.—Operative clinic.

## Friday

## General Surgery

## E. P. NEARY and associates.

9:00 a.m.—Operative clinic.

## Genitourinary Surgery

## H. R. TRATNER, L. F. HUFFMAN, and H. R. WRIGHT.

9:00 a.m.—Operative clinic.

## UNITED STATES MARINE HOSPITAL

## Tuesday

## Genitourinary Surgery

## D. W. MCINTYRE.

9:00 a.m.—Clinic, followed by operations

## Orthopedic Surgery

## T. A. WILLIS.

9:00 a.m.—Nonoperative clinic.

## CRILE VETERANS ADMINISTRATION HOSPITAL

## Tuesday

## WILBERT H. MCGAW, DONALD L. DIAL, N. W. THIESSEN, and VERNON L. TICHY.

9:00 a.m.—Operative clinic.

## WILBERT H. MCGAW.

2:00 p.m.—Presentation of Orthopedic Cases

## Wednesday

## WILLIAM C. MCCALLY, CLAUDE S. BECK, JOHN J. THORNTON, and DARRELL T. SHAW.

9:00 a.m.—Operative clinic.

## WILLIAM C. MCCALLY.

2:00 p.m.—Selection of Cases for Vagotomy.

## Thursday

## EARLE B. KAY, PHILIP F. PARTINGTON, and CYRIL T. SURINGTON.

9:00 a.m.—Operative clinic.

## PHILIP F. PARTINGTON.

2:00 p.m.—Cholangiography as a Diagnostic Aid

## VERNON L. TICHY.

2:00 p.m.—Difficulty in Diagnosis of Regional Enteritis.

# SURGERY GYNECOLOGY AND OBSTETRICS

FRANKLIN H. MARTIN, M.D.

*Founder and Managing Editor 1905-1935*

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*Supplement*

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# INTERNATIONAL ABSTRACTS OF SURGERY

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## COLLECTIVE REVIEW

### COLONIC AND PROCTOSCOPIC DISEASES

ROBERT TURELL, M.D., New York

#### PART II

##### WAR WOUNDS OF THE COLON

**R**ECENTLY there has been an outpouring of papers dealing with abdominal war wounds which include comprehensive discussions of wounds of the colon.<sup>1</sup> Reference is made to some of the important papers that emphasize basic principles and procedures, and due consideration and emphasis are given to the stimulating but controversial ideas that deviate from the "accepted" ones, which appear in the occasional article.

The main object of this discussion is to correlate what has been learned from the wide experiences gained in the management of casualties of World War II, with a view to the application of this knowledge to the treatment of similar wounds in civilian practice.

**Battle Wounds.** War wounds of the colon are so closely bound up with those of the other abdominal viscera that they can hardly be discussed separately. The following points are decisive to the success of colonic (and abdominal) surgery performed in the field.

1. Teamwork is necessary to carry out the preoperative, operative, and postoperative care smoothly.

2. Resuscitation is frequently necessary before surgery can be undertaken. In spite of associated shock, immediate surgery is at times performed. When the shock is due to continuing intra-abdom-

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Part I of this review appeared in the November issue.

inal hemorrhage (35, 20), transfusion of blood is most important in the resuscitation program. Great credit is due Richard Lewisohn for his discovery in 1915 of the citrated method of transfusion of blood, which was the greatest lifesaving measure in the management of casualties in the field of battle of World War II.

Ogilvie (35) believes in copious transfusion of blood before, during, and after operation. The effect of blood loss upon the mortality rate of penetrating abdominal wounds may be disastrous. In civilian practice Hamilton observed a mortality of 17.2 per cent when a loss of less than 500 c.c. of blood occurred; the mortality rose to 41.5 per cent when the blood loss ranged between 500 and 1,000 c.c., and it reached 64.6 per cent when more than 1,000 c.c. of blood were lost. This observation was confirmed by Loria of New Orleans. When feasible, autotransfusions may be carried out.

3. Patients with colonic or rectal injuries were usually given the same priority as were patients with other penetrating wounds in the abdomen. In suspected cases a rectal examination is imperative as the presence of blood indicates an injury. When digital examination fails to disclose a perforation, proctoscopy should be performed (32).

4. Ether-oxygen anesthesia by the closed technique is the anesthetic of choice (Also see chapter on anesthesia elsewhere in the text).

5. The incisions should be as simple as possible. The straight median or paramedian incisions that go through all layers of the abdominal wall in the same plane are the best (35). In civilian traumatic practice similar incisions are advocated (15). In

rectal wounds, Laufman prefers a main right paramedian and a left stab iliac colostomy incision. This plan allows more room for occlusive protective dressings. In closure, the peritoneum and the posterior rectus sheath are well approximated while the remaining layers of the abdominal wall are loosely sutured. The skin is best left open. In civil traumatic practice the abdominal wound is drained by placing a cigaret drain to the peritoneum in order to prevent infection or the possible rupture of an abdominal wall abscess into the peritoneal cavity (15). For rapid closure, through and through sutures of steel, silver wire, or heavy silk may be used.

The technique should consist of a simple overhaul and a rapid repair. The forward surgeon "must have good hands, a stout heart, and not too sound philosophy. He is called upon for decision rather than discussion, for action rather than knowledge of what the best writers think should be done" (35). The surgeon at the front should not necessarily do what he thinks will give the best results, but what he knows will avoid the worst danger (36). The source of intraperitoneal hemorrhage must be stopped with dispatch. This source is usually perforation of a large vessel or a tear in the mesentery. The control of mesenteric hemorrhage may be complicated when more than one vessel is damaged and when the tissues are edematous or blood stained. Ogilvie created the dictum "no mass ligatures, no stitches, no catgut." Mass ligature may compromise the blood supply to segments of colon that could have been saved by careful hemostasis, stitches cause more bleeding than they stop, and catgut has a tendency to slip off when the bowel is handled during exploration.

Exteriorization of the colon is regarded by many writers as the greatest single advance in war surgery of the transverse and left colon. This view is not, however, totally shared by some military surgeons (24, 6), nor by Sloan in civil practice. Hamilton and others have advocated the exclusion of even questionably injured segments of the colon because traumatized areas may become devitalized and may slough away some time after exploration. Observation of exteriorized segments of the bowel shows that small perforations of the colon are usually surrounded by an area of ecchymosis which invariably undergoes necrosis and slough (26). The uncertainty of estimation of the extent of the necrosis makes simple closure of colonic lacerations hazardous. Hurt never sutured unprepared colon except for injuries between the sigmoid and the extraperitoneal rectum, supplementing the suture by a proximal colos-

tomy. On the other hand, Blackburn and Rob, and Imes sutured colonic lacerations without fear. Imes has sutured 25 such cases.

Ogilvie (35) believes that injuries of the fixed segments of the colon should be repaired "as well as possible under the circumstances," the retroperitoneal area should be drained adequately through a separate incision, and a proximal colostomy should be performed. However, the American forward surgeons (20, 13) prefer to mobilize the fixed portions of the colon whenever possible by freely incising the lateral peritoneal reflections with a view to facilitating exteriorization.

A large laceration of the mobile portion of the colon may require resection of the involved segment of the bowel and exteriorization of the proximal and distal loops as a double barrelled colostomy. The stoma is preferably brought out through a separate lateral incision in the hypochondriac region without tension in order to avoid infection in the main wound. The wisdom of this maneuver is questioned by Colcock who found an equal incidence of infection (5 per cent) of the wounds in the cases of stab wound colostomy as in those in which colostomy was incorporated in the original laparotomy wound.

When a retroperitoneal hematoma involving the mesocolon is present, the posterior aspect of the colon must be inspected through an incision in the lateral mesenteric leaf (8). If the colon is injured, exteriorization of the bowel becomes mandatory and drainage of the retroperitoneal space through a flank incision is desirable. This policy also applies to the management of solitary colonic wounds when the site of exit is in doubt.

6. *Colostomy.* Colostomies in the left side of the colon are usually performed for (1) colonic injuries when exteriorization is impossible, (2) rectal injuries, and (3) extensive wounds of the perineum and buttocks.

Adequate mobilization of the colon usually permits rapid formation of a long colostomy spur. This in turn facilitates the future restoration of intestinal continuity. Two rows of serosal sutures uniting the limbs of the bowel are desirable and will effectively prevent the omentum or small bowel from getting between the loops of the colostomy spur; when haste is essential one row of sutures will suffice. These sutures approximate the longitudinal bands of the colon and should be tied without tension. Under no circumstances should these sutures pass into the lumen of the colon. In civil practice, Jones (28) maintains the colostomy loops in position by suturing together several epiploic appendages; he never sutures the colon itself, "neither serosa to serosa nor serosa to

any part of the abdominal wall." The colostomy spur should be so constructed that the subsequent application of the enterotome will not crush the blood supply. Any safe surgical "trick" that will save time finds usefulness in military surgery.

Keene (30, 31) believes that neither a double barrelled nor a loop colostomy effectively diverts the fecal stream. Feces will progress from one loop to another if the two stomas are too close together. He believes that the bowel should be completely transected and the two stomas brought out at different sites on the abdominal wall with regard to spur formation. The two intestinal ends should be separated for at least 6 cm. and different dressings applied to each opening.

The closure of colostomies may be done in one of several ways. The classic procedure entails the crushing of the spur and the closure of the anterior wall of the stoma. Before the enterotome is applied it is imperative to make sure that there are no intervening structures between the loops of the bowel, and that the two intestinal limbs are united to each other. This can usually be established by the simultaneous palpation with an index finger in each loop. Following adequate crushing of the spur, the colostomy is converted into a fecal fistula and closure may be effected by a simple extraperitoneal procedure. When the application of the enterotome produces nausea, vomiting, undue pain, especially pain radiating to the back, and urinary tenesmus, the enterotome should be promptly removed and this type of closure abandoned.

Closure of the stoma without crushing of the stoma is a more difficult procedure. Frequently, but not always, an intraperitoneal maneuver is necessary. If the colostomy stoma is very mobile, closure may be performed by the extraperitoneal route. When narrowing at the suture line appears inevitable the stoma may be enlarged longitudinally and sutured transversely. One drain is inserted down to the sutured bowel and the other into the subcutaneous tissues. Recently Sinaiko proposed another simple method of enlarging and closing the stoma.

Keene has employed a one stage intraperitoneal end-to-end anastomosis combined with delayed closure of the wound for all types of interruption of continuity of the large intestine regardless of the anatomic distortion present. This policy was adopted because over 60 per cent of his 40 cases showed "retraction of the bowel ends, loss of colonic substance, wound sepsis, extensive scarring, and the like." Another 10 per cent of the colostomies treated by him had been "rotated through 180 degrees so that the defecating stoma

is situated distal to the other stoma." This, of course, placed the mesentery between the loops of the colostomy stoma. Unsuspected interposition of the small intestines, mesentery, and omentum was found often enough to warrant revision of all types of colonic stomas regardless of the external appearances. In 3 cases of properly performed Mikulicz colostomies Keene found loops of small intestines so placed that an enterotome would have caused considerable injury. As the result of his successful experience with 40 colostomies or fecal fistulas, Keene established the following preoperative, operative, and postoperative program of treatment.

#### 1. Preoperative preparation.

- a. General measures—the patient should be gaining weight.
  - (1). High protein (red meat) diet.
  - (2). Whole blood, red blood cell suspension, and plasma transfusions.
  - (3). Correction of fluid and electrolyte balance.
  - (4). Vitamins.
- b. Evaluation of the bowel and sphincters by roentgenography and sigmoidoscopic examination.
- c. Anterior Bradford frame care if there is digestion or infection of the abdominal wall.
- d. Daily irrigations of both loops.
- e. A low residue diet, and succinylsulfathiazole (to include the distal loop) should be given for 1 week before operation.
- f. For 48 hours preoperatively, sulfadiazine or penicillin should be given in selected cases.

#### 2. Operative technique.

- a. Meticulous irrigation of the colostomy loops with soapy water followed by large amounts of sterile water.
- b. Complete freeing and mobilization of the bowel ends.
- c. Restoration of the anatomic continuity by intraperitoneal end-to-end anastomosis. Two layers of sutures, a through-and-through continuous inverting suture of chromic catgut (size 00), and a serosal layer of interrupted mattress-type No. 60 cotton are used.
- d. Closure of the peritoneum, transversalis fascia, and inner muscle with interrupted chromic catgut (size 1). Silk worm gut sutures are then placed through the skin and outer fascia but not tied. This eliminates serosanguineous discharge and leaves the wound dry.

- e. Wound packed open with one layer of petrolatum gauze plus dry gauze.
3. Postoperative care.
  - a. Wound inspected at 48 hours and, if clean, silkworm gut sutures are pulled and tied.
  - b. Nothing by mouth for 48 hours, then fluids and low residue foods with progressive liberality.
  - c. Intravenous fluids, penicillin, or sodium sulfadiazine continued as indicated.

Routine follow up roentgen studies showed only 1 case of asymptomatic constriction.

7. Simple lacerations of the cecum in the absence of retroperitoneal involvement may be converted into a tube cecostomy with good results. Extensive wounds of the terminal ileum, cecum, and the lower segment of the ascending colon are difficult to manage because of the irritating effect of the intestinal drainage. There is considerable division of opinion as to the proper surgical attack. The iliac stoma is best separated from the colonic stoma by the construction of an ileostomy and the exteriorization of the colon through separate incisions. The anastomosis between the small bowel and the transverse colon should be effected at the earliest practicable moment.

8. *Wounds of Rectum.* Laufman, in an excellent article, stated that contamination of the perirectal space may take place from within and without and described the anatomy of the rectum exceedingly well. The initial operative treatment of penetrating wounds of the rectum, as seen in an evacuation hospital, consisted of (1) complete débridement of the tract, (2) adequate incision of the fascia propria to decompress the perirectal space with suture of the rectal wall when the defect was large, and (3) the construction of temporary proximal colostomy. (Some authors prefer a sigmoid colostomy, while other surgeons, notably Gordon-Watson, prefer a transverse colostomy.) Free posterior drainage was best accomplished by incision of the fascia propria with exposure of the rectal, sacral, and lateral paramedian spaces through a parasacrococcygeal incision without a coccygectomy. Coccygectomy was performed only if concomitant injury to the coccyx was present. If two perforations existed, the incision was placed on the side having the larger laceration, there was no need for an incision on both sides. An attempt was made to close the large rectal wound, especially when it could be found readily. If the defect was small, as visualized by proctoscopy, the rectal laceration was not sutured. Hurt preferred to suture all rectal perforations, while Jarvis and his associates refrained from suturing the rectal wounds because these

usually healed following adequate posterior drainage.

It is highly important to look for concomitant rectal injuries in all entry wounds of the buttocks, the perineum, and the thighs. Such an undetected injury may lead to fatal pelvic cellulitis.

In the event that in the course of a laparotomy there is doubt whether a bullet which entered the buttock or perineum might have gained entry into the true pelvis or the pouch of Douglas, the pelvis should be swabbed with a sponge on a stick as absence of blood on the sponge eliminates the likelihood of perforation (20).

9. Ogilvie (35) observed that "the surgeon who drains most often saves most lives." Estcourt and his collaborators concurred with Ogilvie. They preferred to drain through a stab wound or through the battle wound if it was well placed; they never drained through the main exploratory incision. Blackburn and Rob drained only when the peritoneal cavity was grossly contaminated by feces or bile.

10. Gastric suction is of paramount importance because ileus invariably occurs (35). Nasogastric suction and intravenous therapy with whole blood, protein, plasma, sulfonamides, penicillin, and fluid are continued until equilibrium of the patient is established. A urinary output of 1,500 c.c. is important, especially when sulfonamides are employed. Parenthetically, sulfonamides and penicillin appear about equally effective in the prevention of peritonitis. In general, experience in war surgery has not justified the enthusiasm for chemotherapeutics in the treatment of peritonitis in civilian practice (26).

Intestinal (abdominal, in general) casualties are kept in the forward centers until they have regained equilibrium—an average period of about 10 days. These patients cannot stand travel; even a small move may be fatal. Whenever the military situation necessitated early transport the mortality of these cases invariably rose. Estcourt *et al.* pertinently pointed out that these patients can be moved with fair safety before, but never after, operation.

11. Contamination of the peritoneal cavity (with localized sepsis) and renal insufficiency are two outstanding complications (26). The occurrence of intestinal obstruction or fistulas is quite commonly observed. Individualized appropriate treatment and measures to prevent protein and vitamin depletion should be instituted at an early date.

Rogers called attention to the following danger signs: (1) persistent hiccup starting even during the operation; (2) slow, persistent distention with

a silent abdomen; (3) continual anxiety; (4) tachycardia, and (5) diminution of the urinary output.

Barney and his associates (*Med. Clin. N. America*, 1946, 30:337) reported the frequently encountered mechanical intestinal obstruction following celiotomies for abdominal war wounds. The intestinal obstruction is produced by adhesions. (Also see Garlock's comments elsewhere in the text). In the colon, an inadequate lumen may result following the performance of the Paul-Mikulicz type of colostomy closure.

*Underwater Explosion.* Cameron, Short, and Wakeley reported their clinical and experimental studies of abdominal injuries due to pressure waves of underwater explosions. The solid abdominal viscera are seldom injured, whereas the gas containing gastrointestinal system is susceptible to grave injuries. The intestinal lesions vary from small intramural hemorrhages to complete tears of the wall. The colon was involved more frequently than the small bowel or the stomach. Experimental studies on goats revealed striking damage to the colon. The lesions consisted of annular hemorrhage in the intestinal wall, perforation of the bowel with prolapse of mucosa, effusion of blood into the lumen, and rectal bleeding.

Gage reported his clinical experiences with 98 men who had survived a sinking at sea and a subsequent depth charge explosion. Practically all the injured men stated that they felt as if they had been kicked in the injured region when the depth charge went off. Twenty-three patients suffered from serious intraperitoneal injury. Practically all of the casualties estimated that they were within 100 feet of the depth charge when it exploded; they were either on their abdomens or they were in water above their abdomens facing the blast. Conservative treatment was instituted because these patients were seen about 36 hours after the explosion. Four of the 23 patients died of generalized peritonitis; these patients were at no time in condition for surgical intervention. Operation instead of nonoperative treatment might have been indicated in some of Gage's patients had they been received within 10 or 12 hours after the injury. Secondary perforation of a viscus occurred in 2 sailors; in one the perforation occurred 40 days after the injury. One patient was promptly operated upon and recovered. Gage believes that nonsurgical treatment is indicated when the optimum period of surgical intervention has passed.

#### CIVIL TRAUMATIC ABDOMINAL WOUNDS

A number of excellent papers dealing with civilian abdominal injuries have recently been pub-

lished (15, 48, 64). The paper by Dixon, Martin, and Ochsner is reviewed in detail for further emphasis and because the ideas and procedures described therein follow quite closely those associated with war wounds in the forward areas. These authors reviewed 88 personal cases of abdominal injuries encountered in New Orleans. An exploratory laparotomy was performed (1) when shock continued for over an hour in spite of antishock treatment, (2) when lacerated bowel extruded from a torn abdominal wall, (3) when there was an unmistakable rupture of a hollow viscus, (4) when increasing abdominal pain and rigidity was present, and (5) when air under the diaphragm was observed. As in military surgery of forward areas, the paramedian incision is favored. In the absence of free bleeding, exploration is begun at the middle of the transverse colon and is extended toward the right side to the cecum and then toward the left side to the rectum. Then the small bowel is investigated, beginning at the ligament of Treitz to the ileocecal valve. Solitary small intestinal perforations are closed by single pursestring sutures which are reinforced with interrupted fine cotton sutures. For multiple perforations in close proximity, resection with end-to-end anastomosis is carried out. Longitudinal lacerations are closed transversely. Large perforations are closed by means of a Connell stitch and triple zero chromic catgut on an atraumatic needle; this is reinforced by interrupted Lembert cotton sutures. Small lacerations of the colon are treated as has just been outlined; extensive injuries require exteriorization. Systemic sulfonamide chemotherapy is preferred to the intraperitoneal administration. The peritoneum is closed with interrupted cotton sutures.

A detailed discussion of the postoperative care and complications (atelectasis, thrombophlebitis, phlebothrombosis, and localized intra-abdominal infection) is presented.

*Traumatic Perforation.* Kaufman, Sepico, and Mosig reported 3 cases of traumatic perforation of the rectosigmoid; one was the result of a rectal biopsy, another was caused by a colonic irrigation, and a third by an enema. The intestinal wall was normal in all of these cases. The authors stated that the "foreign literature abounds with reports of rectal injuries due to enema and sigmoidoscopy." A few such reports have emanated from the United States. Alvarez stated that "in my experience I have yet to see a colon which was injured demonstrably by years of enema taking." Kaufman and his associates have reviewed the literature and found that perforation has been caused by the following: (1) sigmoidoscope; (2) enema tips, syringes, nozzles, high colonic

tubes; (3) thermometers; (4) bougies and rectal dilators; (5) electrodes for fulguration of polyps; (6) urethral sounds while making false passages; (7) colpotomy; (8) gunshot wounds; (9) impalement; (10) fracture of the pelvic bones; (11) misguided attempts at abortion; (12) accidents in industries; (13) practical jokes; (14) transurethral operations; (15) hydrostatic pressure; (16) sadism or sexual perversion, and (17) sodomy. All 3 of Kaufman's personal cases were operated upon with 2 survivals. Immediate operative interference is advocated.

Swenson and Harkins reported the sixty-fourth case of perforation (2 complete and 1 incomplete laceration) of the rectosigmoid which was caused by compressed air. They believe that immediate operation is indicated even in suspected cases; the method of repair or suture is, to a great extent, dependent upon the ingenuity of the surgeon. The incomplete lacerations may be sutured longitudinally in the direction of the rupture.

The general consensus favors immediate closure of the perforation because delay of 7 or more hours is invariably fatal (Pearse, H. E.: *Arch. Surg.*, 1941, 42: 850). Occasionally perforations of the rectum or sigmoid which occur during sigmoidoscopic examination may be treated conservatively, especially when a delay of several hours has occurred before the diagnosis was established or in the case of the aged or poor-risk patient (Sallick, A. M.: *Surgery*, 1940, 8: 473).

**Rupture of the rectovaginal septum.** Wharton reported an unusual case of spontaneous perforation of a rectovaginal septum which was successfully repaired by a simple surgical procedure.

**Rectourinary fistula.** Wilhelm presented 18 cases of rectovesical or rectourethral fistulas that were caused primarily by surgical trauma and malignant disease. Six cases were seen shortly after perforation had occurred, and in 3 of these the fistulas were cured by such measures as control of hemorrhage and urinary drainage, intestinal bacteriostasis, and induced constipation. Radical reparative surgical procedures were employed in 5 of 9 chronic rectourinary fistulas. Suprapubic cystostomy was instituted in all these cases. Preliminary colostomy was superseded by succinylsulfathiazole chemotherapy. Four fistulas were repaired by the perineal technique of Young, while a modified Young procedure was utilized in 2 other cases. A case of ileorectovesical fistula was repaired through an abdominal approach. Wilhelm believes that rectourinary fistulas caused by trauma or acute inflammatory process will respond to conservative therapy, while those due to a malignant process have a poor outlook.

**Foreign Body.** Porter reported an interesting case of a Marine who had been attacked and who had "a piece of wood shoved up his rectum." Following this the patient suffered from indefinite abdominal pain, difficulty in urination, and rectal bleeding. Urination was possible only in the sitting, but not in the standing, position. Roentgenography disclosed a straight and perpendicular rectal shadow. Digital rectal examination elicited what appeared to be an "end of a stick 1½ inches inside the rectum." Under spinal anesthesia with the aid of an Ochsner forceps "a stick of wood 10 inches in length and ¾ by 1¼ inches thick was removed. One edge of the stick was irregular, sharp and jagged." Twenty-four hours following the removal of the foreign body the patient voided, and he had a normal bowel movement within 48 hours.

#### BLEEDING

Stone (50) contributed a very instructive paper dealing with severe bleeding from the rectum which occurs suddenly and produces, at times, varying degrees of shock. It is extremely difficult or impossible to establish the cause of this condition. As a result of his diagnostic efforts, Stone divided these cases into: (1) those in which a definite cause was established; (2) those in which a lesion was discovered that might have been responsible for the bleeding, and (3) those in which no cause could be discovered in spite of intensive investigation. Patients in the third group, mainly those with no detectable lesions, may either bleed intermittently or may never bleed again after the initial episode. Stone listed the following lesions as those which may be suspected or proved as the cause of bleeding: (1) benign tumors, such as polyps and hemangiomas; (2) malignant neoplasms; (3) gastric, duodenal, intestinal, and colonic ulcers including ulcers in Meckel's diverticulum; (4) diverticulosis; (5) regional ileitis and colitis; (6) vascular lesions, such as varicose veins, infarctions, miliary aneurysms; (7) trauma from ingested foreign bodies; (8) erosions from pressure of extraintestinal lesions such as aneurysms of the large vessels; (9) blood dyscrasias, and (10) hypertension.

The undiagnosed cases were treated by immediate resuscitative or restorative therapy followed by diagnostic studies; operative interference was avoided as surgery is futile and invites trouble. Operation is indicated for the definitely diagnosed lesions and for those of questionable character if they are believed to be amenable to surgical treatment.

Pfleiffer added to the foregoing list of causes, on the basis of his experience, a small mucous erosion

into an esophageal vein that was discovered at autopsy. Jones (27) reported an interesting case of a resectable reduplication of the small intestine in a girl 5 years of age, which was apparently the cause of the profuse bleeding. Ochsner emphasized cholecystitis and the ingestion of large amounts of acetylsalicylic acid as causes of obscure bleeding from the rectum. The reviewer has encountered rectal bleeding as a result of the administration of 12 gm. of aspirin in divided doses during a period of 24 hours. The bleeding is probably caused by hypoprothrombinemia, which can be relieved by the administration of vitamin K. Christopher stressed hemangioma of the small bowel as a frequently overlooked source of profuse rectal bleeding. Resection of the tumor bearing bowel resulted in complete recovery. Truesdale believes that esophageal hiatus hernia is a frequently overlooked cause of melena. The bleeding is caused by an abrasion or erosion and originates from varices of the cardia or from the base of an ulcer. A rare cause of bleeding from the rectum is carcinoma of the appendix (58).

Baldwin contributed another interesting article on the causes of rectal bleeding. He stressed the fact that hemorrhoids are the most common, and carcinomas the most important causes of rectal bleeding. The lesser known causes of rectal bleeding are arteriosclerosis, uremia and poisoning by arsenic or mercury bichloride. The importance of an accurate history and a proper examination was stressed. Underwood emphasized that rectal bleeding is still frequently inadequately evaluated. Harris stated that a benign bleeding lesion in the anorectum may coexist with a malignant lesion higher up. The importance of this fact should not be underrated because a large number of cases of rectal and colonic malignancies are overlooked when benign lesions, such as hemorrhoids, are found; usually a complete sigmoidoscopic examination is not performed in such cases. Many cases of malignancy in the terminal bowel undergo hemorrhoidectomies because of rectal bleeding. Only continued bleeding from the rectum after hemorrhoidectomy leads to further investigation and to the discovery of the previously overlooked malignant lesion. Garlock, Ginzburg, and Glass stated that about 25 per cent of the patients with cancer of the rectum seen by them had had a hemorrhoidectomy done elsewhere from 2 to 5 months prior to admission to the Mount Sinai Hospital, New York.

#### DIGITAL EXAMINATION

Stone (51) succinctly stressed the importance of a digital examination combined with sigmoido-

scopy in studying lesions of the lower segment of the digestive tract. Serious disorders, such as carcinoma, which are situated within the reach of the examining finger are overlooked because of the omission of a digital examination. Baldwin stated that from 60 to 65 per cent of all cancers of the colon and rectum occur within the reach of the index finger. There appears to be a reluctance, and even an aversion, on the part of some physicians to insist on a proper digital examination or to train themselves to perform this examination. The late Doctor Brenneman believed that a "rectal examination is an extremely unpleasant experience" and avoided its employment. On the other hand, Peterman voiced his astonishment at the rarity of the performance of a rectal examination in children. Obviously Brenneman's objection and the avoidance of a rectal examination are not shared by all pediatricians. The reviewer's experience with juvenile proctology is not in accord with Brenneman's experience.

In adults, a rectal examination is of distinct help in arriving at the correct diagnosis of appendicitis as it frequently demonstrates tenderness on the right side which results from the inflammatory appendical process in the pelvis (17). Strauss believes that a rectal examination should be made in addition to the examination of the abdomen in all cases of appendicitis.

In the study of intussusception even Brenneman employed digital rectal examination and he stated that in infants suffering from this lesion one should "pay no attention to the painful procedure." Upon withdrawal of the examining digit a turbid currant-jellylike mixture of blood and mucus very often appears, which is pathognomonic of this lesion; occasionally a cervixlike mass with a central dimple may be felt.

Berk, in a study of gastrointestinal problems encountered in the Army, stated that "no single examination is so valuable and informative as is the digital examination of the rectum."

#### HEMORRHOIDS

There were 2 papers dealing with a surgical departure from the usual anatomic dissection of hemorrhoids (4, 41). Benjamin and his associates free the mucosa from the hemorrhoidal vessels through a small linear incision on the perianal area perpendicular to the anal opening which is about 1.5 cm. from the dentate line. After freeing the hemorrhoids, the hemorrhoidal vessel is morcellated by short bites with scissors. Apparently only ulceration of the mucosa makes such dissection impossible and impracticable because the mucosal continuity cannot be preserved. Rakov



enucleates the hemorrhoidal tumor through a radial incision which begins in the perianal skin close to the hemorrhoidal mass and is carried into the anal canal to the apex of the hemorrhoids. Redundant skin may be removed according to the needs of the individual case. All primary hemorrhoids are thus removed while the secondary ones are dissected submucously through the original incision. Intra-anal packing is avoided because the insertion and the removal of such packing elevates the otherwise flattened cutaneous and mucosal flaps and thus predisposes to "tag" formation. The advantages claimed for this procedure are: (1) the simplicity of technique; (2) the absence of complications and sequelae; (3) diminution of postoperative pain as well as of the period of convalescence, and (4) a better final cosmetic result. This operative procedure is akin to that described by Calman (*Am. J. Surg.*, 1941, 53: 428).

In criticism of the foregoing procedures it may be stated that at least 50 per cent of the patients requiring hemorrhoidectomy have concomitant local lesions which are the result of a local inflammatory process, that also require surgical excision. In fact, the current widely accepted belief is that infection of the anal and perianal tissues, preceded or accompanied by passive congestion, is apparently an important single etiologic factor in hemorrhoid formation. It is the belief of some authorities that inflammation and infection are a common denominator in many anorectal lesions, hemorrhoids included. Hence, the operation of choice for such cases is a nontraumatic procedure that will eliminate not only the hemorrhoidal varices but also the sources and channels of infection, and which will, in addition, provide ample drainage through open wounds in order to promote the restitution of the inflamed and/or infected anal and perianal tissues. The surgical procedures of Milligan-Morgan or Buie have a sound anatomic basis and a perfect underlying surgical principle.

In wartime there was an urgent necessity to save duty hours and therefore to speed up the time of effective healing of anorectal wounds. With this in mind the reviewer deviated from the open nontraumatizing type of hemorrhoidectomy and began to employ the semiclosed and closed types of technique. After a clinical trial with these methods of hemorrhoidectomy in the treatment of large groups of patients he became convinced that the semiclosed type of hemorrhoidectomy, which is very much akin to the procedures of Milligan and Morgan but the subcutaneous structures of the hemorrhoidal bed are approximated

without suture of the skin, is a good procedure in the absence of inflammation or infection of the anorectal tissues. Sulfonamide or antibiotic chemotherapy should be utilized before, and continued after, surgery.

The closed type of hemorrhoidectomy in which all tissues including the skin were closed proved to be an undesirable surgical procedure even when combined with sulfonamides and/or antibiotics, because of the high incidence of complications which far outweighed the advantage of saving duty days.

The electrothermic method of hemorrhoidectomy (Warshaw, Arnheim) was also employed in cases that were deemed suitable for the semiclosed or closed methods of hemorrhoidectomy. It was found to be equally as good as the semiclosed technique and far superior to the closed type of hemorrhoidectomy.

Whitney and Angelo emphasized the value of posterior sphincterotomy in hemorrhoidectomy. Among the many advantages of this procedure are the prevention of postoperative anal sphincter spasm and pain. The reviewer has employed posterior sphincterotomies with satisfaction as a part of hemorrhoidectomy only in those cases in which unexplained preoperative anal sphincter spasm was present. In posterior sphincterotomy the incision is made perpendicular to the fibers of only the subcutaneous component of the external anal sphincter muscle.

#### PROLAPSE

Smith treated 5 patients with rectal prolapse by a modified procedure of compression amputation. Four of these patients were elderly and frail and had cardiovascular disease, and the fifth was obese. In 4 patients the results were considered good, although postoperative narrowing at the site of amputation was present in 2; the fifth patient had had 2 recurrences. Hayden stated that the experience at the Massachusetts General Hospital indicates that rectal prolapse can be successfully treated by a number of different surgical procedures, and that Smithwick had performed several Delorme operations with considerable success.

The Delorme operation which has been popularized in the United States by Bevan and David is an effective procedure because it not only corrects the prolapse of the bowel, but restores the atonic anal sphincter muscles which have been dilated by the prolapse. The reviewer has modified and simplified the Delorme procedure and has employed it successfully in 5 cases that have been followed up for a long time, and in 2 recent cases.

Under infiltration or low spinal anesthesia with the patient in the inverted or lithotomy position the prolapse is maintained at its full length with the aid of Allis or Babcock forceps. The lithotomy position is employed when a perineorrhaphy is also contemplated at the conclusion of the rectal operative procedure, which requires a complete change of instruments, gowns, gloves, and complete re-draping of the patient. If the patient is placed in the inverted position, a V-shaped incision is first made in the anterior arc of the perianal skin about 1.5 cm. from the anal verge and the dissection is carried cephalad into the anal canal to the apex of the prolapse. Here the incision ends in a V-shaped manner corresponding to the one in the circumanal area and effects an elliptically shaped excision of as wide a strip of mucosa as is deemed necessary. If the lithotomy position is employed the dissection is begun in the posterior aspect. This is done in order to keep the operative field of the opposite side free from blood. The subcutaneous component of the anal sphincter muscle is visualized. At the mucocutaneous junction (pectinate line) the mucosa is thin and friable and requires gentle handling to facilitate the uninterrupted dissection in the proper line of cleavage. The mucosa is usually separated from the muscularis of the prolapsing segment of the bowel by blunt dissection with the aid of curved Mayo scissors; sharp dissection may occasionally be used. Bleeding and oozing may be considerable in amount during the process of separation of the mucosa from the underlying structures and must in all instances be carefully controlled. Perfect hemostasis is essential as elderly patients do not stand loss of blood very well.

Dissections similar to that just described are made in each of the three remaining aspects or quadrants of the circumanal arc of the prolapsed gut. It is important to preserve enough anal skin between these dissections in order to prevent post-operative anal stenosis.

After completion of these dissections, a suture of zero, or finer, chromic catgut is introduced into the denuded area of the muscularis beginning just above the mucocutaneous junction; several bites in successive segments of muscularis are taken until the summit of the prolapse is reached. After these sutures are tied, the formerly prolapsed bowel is pleated or plicated and collapsed in an accordionlike manner; it becomes situated in the pelvis above the puborectalis portion of the levator ani muscle. A small Penrose drain is introduced into the anal canal and removed in 24 hours.

When a perineorrhaphy is performed the levator ani muscles are approximated well in front of the

rectum in order to provide anterior and lateral support to the perineum, anus, and rectum. A procedure akin to perineorrhaphy may be performed in men by making an incision in the perineum as for the classic perineal prostatectomy. The levator ani muscles may be brought together in front of the rectum with ease in order to exert a supportive action.

In summary, this modified operation consists of: (1) segmental excision of the mucosa of the prolapsed bowel; (2) segmental excision of the anal and perianal skin; (3) elimination of the plecting of the external anal sphincter muscle, and (4) the incidental provision of drainage of the rectal wounds to the exterior through the anorectal wounds. Parenthetically, in the presulfonamide era such drainage was regarded as a cardinal necessity in anorectal surgery.

#### FISTULAS

Jackman discussed the pertinent reasons for failure of operations for anal fistulas. He reviewed the records of 500 patients suffering from anal fistula and found that 43 per cent of these patients had undergone from 1 to 14 unsuccessful operations prior to coming to the Mayo Clinic. Faulty conception of the origin and course of the disease, confusion in regard to the anatomy and terminology, mistaken diagnosis, fear of causing rectal incontinence, inadequate postoperative care, failure to appreciate the danger of performing anorectal operations in the presence of infectious diarrhea, inadequate anesthesia, and lack of teaching facilities in our medical schools are the most frequent causes for failure of the surgical treatment of anal fistulas.

Jackman pointed out that the rules promulgated by John Aderne more than 500 years ago still hold good, namely, that a fistulous tract should be opened from its source to its termination regardless of how much sphincter muscle intervenes. Some surgeons fear to cut through the anal sphincter muscle because of the danger of producing an incontinent anus. The cure of fistulas demands that all tissues overlying fistulous tracts should be incised regardless of the intervening muscle. The chief causes of incontinence are faulty packing or neglect of early treatment of the inflammatory process which irreparably destroys the sphincter muscle. The post-operative care is considered as important as the operation itself.

#### INCONTINENCE

Ruzic and his associates presented a new method of reconstruction of the sphincter mech-

anism in traumatic or operative anal incontinence. A strong objection may be registered to their use of oil soluble anesthetics as an adjunct to such plastic procedure for Truman has recently shown experimentally that these anesthetic agents tend to delay and prolong the process of healing, to increase the inflammatory reaction, and to produce increased scar formation. Those surgeons employing oil anesthesia in wounds should be aware of the facts and ready to accept an increased inflammatory reaction and delay in healing (56). The reviewer has repeatedly called attention to the objectionable features of the long acting (water or oil soluble) anesthetics when applied to wounds (*Am. J. M. Sc.*, 1941, 202: 282; *Surg. Gyn. Obst.* [Internat. Abstr. Surg., 1943, 76: 193]). There are many competent proctologists who believe that when clean cut surgery plus preoperative and postoperative care are employed there is no need for the long acting anesthetics; at best these agents are poor substitutes for good surgery. Ferguson believes "that their disadvantages seem to outweigh their advantages."

Blaisdell, several years ago, contributed a constructive series of papers dealing with the problem of incontinence. The surgical principles then enunciated have been recapitulated in a recent article. The reader is referred to the original papers and to one of my past reviews (*Am. J. M. Sc.*, 1941, 202: 282).

#### PLASTIC PROCEDURE FOR PRURITUS ANI

Young and Scott have proposed a plastic two stage surgical procedure for intractable anal pruritus. The operation is performed by excising one-half of the perianal skin at one time in order to avoid possible postoperative infection with subsequent prolonged healing and scarring which in turn may result in contracture of the anal aperture. Following excision of the involved skin on one-half of the circumanal area a flap of healthy skin from the medial surface of the buttock and thigh is immediately shifted to the excised area. The technique is as follows:

"An incision is made at the mucocutaneous junction around one-half the circumference of the anus. The mucosal edge is prevented from retracting inward by a number of guy sutures which are held by an assistant. The external sphincter muscle is exposed and the scarred skin and subcutaneous tissues are dissected from it. A plane of dissection is found under the leathery area and the dissection is carried outward from the normal skin. The flap of scarred tissue is then cut away. A flap of skin and subcutaneous tissue of correct

size and shape to cover the defect is cut lateral to the defect with its base posteriorly. It is swung across and sutured to the anal mucosa and to the medial lines of excision. The defect left laterally is sutured as far as possible. If tension is observed, the remainder of the defect is left to granulate. A small rubber drain is brought out from under the flap at its base and a snug perianal binder is applied to hold the flap securely in apposition to its bed. The bowel is prevented from moving for 10 to 14 days depending upon the speed of healing. Infection is moderate. There is usually some inflammatory reaction along the suture line but not enough to interfere with healing. In 2 to 3 months the remaining half of the perianal skin is removed and sutured in the same manner."

Two of the authors' 3 patients have been symptom free long enough to be regarded as permanently relieved; the third patient was still undergoing treatment at the time of writing of the present article. This operative procedure is a welcome addition to the therapeutic armamentarium of intractable anal pruritus especially in view of its apparent simplicity and easy execution. The reviewer treats intractable pruritus ani by tattooing the involved cutaneous area with mercury sulfide. Most patients who show characteristic cutaneous changes that are associated with pruritus of long standing but without associated anorectal lesions have responded well to tattooing (*J. Invest. Dermat.*, 1940, 3: 289; *Am. J. Obst.*, 1941, 42: 299; *Ann. Surg.*, 1942, 115: 126; and *New York State J. M.*, 1942, 42: 1335).

#### CONDYLOMATA ACUMINATA

Culp and Kaplan reported on the successful treatment of 200 cases of condylomata acuminata occurring at various anatomic sites, including the anal and perianal regions, with podophyllin as a 25 per cent suspension in mineral oil. Ross has employed this drug in the powder form with equally successful results. Most lesions disappeared within 4 days after a single application of podophyllin. No ulceration or scarring followed this therapy. Recurrence or new condylomata may occur since this form of therapy does not remove the primary cause. Podophyllin may also be used in granuloma inguinale and for the destruction of excessive granulation tissues in surgical wounds; for the latter it is superior to silver nitrate. Podophyllin is of no value for the eradication of horny verrucae, condylomata lata of syphilis, or benign intestinal polyps.

Anderson (*Arch. Dermat. & Syph.* 1946, 54: 66) employs a 10 per cent tincture of resin of podophyllum. Sullivan (personal communication) uti-

lizes a 20 per cent podophyllin in 95 per cent alcohol. These solutions may be applied to the lesion with a cotton swab or camel's hair brush.

#### CRAMP IN RECTUM

Pruitt recently described the clinical characteristics of 23 patients suffering from cramp in the rectum. The pain occurred most often at night during sleep and was "intense, spasmodic and tonic in type, of short duration and localized by the patient as 'in the rectum.' The pain was unaffected by the act of defecation and disappeared spontaneously without sequelae. The cause is obscure and relief of pain is usually spontaneous." Rosser believes that the condition described by Pruitt is produced by an intussusception of the sigmoid into the rectum which occurs during sleep and is frequently relieved by activity. Andrews described a similar condition which was produced by a neuroma of the spinal cord which was removed surgically with complete relief. Brashear recorded 1 instance of nocturnal rectal cramp in a man who was relieved by transurethral resection of the prostate, and another case in a woman who experienced complete relief following a pelvic operation. Thiele believes that the syndrome described by Pruitt represents acute spasm of the levator ani muscles. Thiele, as a result of his continued studies, thinks that spasm of the levator muscles is due either to injury of the coccyx or to chronic infection in the adjacent organs such as anal structures, posterior urethra, prostate, cervix, or vagina. Massage of the levator ani muscles plus the elimination of the local foci of infection (cryptitis, prostatitis, endocervicitis) is the effective treatment.

While on the subject of foci of infection it is not amiss to note that authorities agree that it is unwise to allow a focus of infection to remain if it can be eradicated without detriment to the host. The removal of anorectal focal infection is technically easy and does not entail the sacrifice of vital structures.

#### BACKACHE IN GASTROINTESTINAL DISEASE

Rivers and Roodenburg have presented an important and enlightening article dealing with the mechanics and pathways of back pain in disease of the gastrointestinal and accessory gastrointestinal (gall bladder and pancreas) tracts. In diverticulitis of the colon when localizing pain over the abdomen develops there may be some back pain which coincides with the location of the abdominal pain. With the formation of diverticular abscess associated back pain is the rule. "Usually this can be utilized in arriving at an accurate lo-

calization of the lesion because it corresponds quite definitely in segmental distribution to the intra-abdominal spinal nerves involved by the spread of the infectious process." In ulcerative colitis with deep involvement of the colonic wall, back pain is present. Only when the lesion is extensive and has penetrating characteristics is the back pain noticed, otherwise it is not recorded by the patient except on direct questioning as pain is overshadowed and obscured by other manifestations of the disease.

In carcinoma of the colon and rectum back pain usually signifies a penetrating type of lesion; hence, its diagnostic and prognostic importance. Cancer of the rectum may produce pain in the sacral area whereas a carcinoma of the sigmoid colon frequently is productive of pain in the lumbar region. Occasionally back pain is the only complaint. Cancer of the other segments of the colon seldom produces pain except when fixation to an adjacent organ takes place during the progression of the erosion of the disease. Then there may occur severe localizing back pain which is usually ipsilateral to the portion of the organ involved. The authors believe that unilateral shifts of pain are due to the cord along the branches of the spinal nerves. Malignant lesions may metastasize to the vertebral column; in these cases the pain is boring, localized, bilaterally felt, and constant. In such connection, attention should be called to the anatomic studies of the vertebral system (Batson) through which the spread of cancerous intraperitoneal organs to the vertebral system can take place (33). This has been discussed elsewhere in the text.

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## PART III

## IMPORTANT ALLIED SUBJECTS

THE important recent advances in the fields of biochemistry and physiology alone have greatly affected the practice of surgery, of which coloproctology is an important branch. The early recognition of pathological processes and the ability to treat disease properly are greatly influenced by a wide knowledge of basic physiological processes. The modern surgeon is to a degree an anatomist, surgical pathologist, and a physiologist. In surgery and its specialties, one must keep abreast of progress in all biological sciences in order to be in a position to take better care of the patient. It is with these principles in mind that most of the following subjects have been incorporated in this review.

*Metabolic studies.* Coller and his associates (11) have shown that there is a high incidence of salt intolerance following general anesthesia. Therefore they recommended that saline solutions be withheld the day of operation and during the first 2 days after surgical intervention, and that dextrose solutions in distilled water be used to satisfy the fluid requirements.

Great care should be exercised especially in administering isotonic saline or Ringer's solution to patients who are hypoproteinemic, anemic, acidotic, or oliguric.

Ireneus is in complete agreement with the work of Coller and his collaborators, and called attention to the infrequent hypochloremic state that many develop postoperatively. The hypochloremic state is a rare clinical entity and is equivalent to heat exhaustion. The advanced symptoms of this condition simulate those of surgical shock and extreme prostration. The clinical picture of the hypochloremic state is difficult to differentiate from salt intoxication, the acute abdomen, postoperative ileus, and intestinal obstruction due to nutritional edema; only the estimation of the blood chlorides clinches the diagnosis. Active treatment is obvious—the administration of massive doses of fluid and salt plus cortical adrenal extract as an aid to the retention of salt in the tissues (Soffer *et al.*, 1944). Prophylaxis consists of frequent determinations of the blood chlorides in suspected cases and the use of saline solution when indicated.

*Continuous spinal anesthesia.* Numerous comprehensive articles dealing with the continuous or fractional method of spinal anesthesia (Lemmon) have appeared in the recent literature. A continuous drop method of inducing and maintaining spinal anesthesia has recently been proposed and is now on trial (Arrowood and Foldes). With continuous spinal anesthesia it is possible to obtain

literature and his own observations Leithauser concluded that early rising should be instituted during the first 24 postoperative hours when the vital capacity is at a low level; immediately after recovery from the anesthetic is the best time.

There occurred no eversion in the 900 of his personal cases. "The tensile strength of sutures is greater during the early postoperative period and healing is promoted through ambulatory activity." Early rising relieves postoperative distress, promotes rapid recovery, and returns the patient to work early. These aspects have special value in military practice. "The chief obstacle to early rising is fear and respect for tradition on the part of the surgeon and patient."

Nelson critically analyzed a series of 429 operations performed through 426 incisions of the anterior abdominal wall after which early ambulation was instituted. The majority of his patients walked the day of the operation or within the first 24 hours. Nelson is in substantial agreement with Leithauser's studies and conclusions. Nelson believes that early postoperative ambulation is a sound advance in surgery and recommends its universal adoption.

Andrus and Barnes listed the following as contraindications to early ambulation: (1) cardiac failure, (2) shock, (3) severe anemia, (4) cachexia, (5) hemorrhage, (6) the possible presence of thrombi and emboli, (7) peritonitis, (8) cholangitis, (9) pancreatitis, (10) liver infections, (11) potentially infected wounds, (12) copious tamponade, and (13) prolonged preoperative rest.

*Intravenous clotting.* In recent years clinicians, primarily surgeons, have recognized the frequency of intravenous clotting originating in the deep veins of the legs as an all too frequent source of fatal and nonfatal pulmonary embolism. These "recent" facts have, however, been known to pathologists for a long time. Castleman, on the basis of autopsy investigation, asserted that in about 95 per cent of the cases seen at the Massachusetts General Hospital the source of pulmonary embolus resided in the deep veins of the legs. McCartney studied the records of 25,771 autopsies and found that 4,070 of the deaths followed operative procedures. In his postoperative material there were 471 cases, 11.5 per cent, in which thromboembolism was present, and 216 patients, 5.3 per cent, who had apparently died as a result of pulmonary embolism. Further analysis of the autopsy material showed that thrombosis or embolism followed surgery performed upon certain parts of the body. Fatal embolism following colonic surgical procedures occurred in 5.4 per cent of the cases; these operations took fifth place among the

operations which might lead to fatal embolism and seventh place among those which were actually followed by fatal embolism. Appendical operations took fourth place with regard to the number of fatal embolisms which occurred. McCartney's figures also showed that the incidence of venous thrombosis, with or without pulmonary embolism, and of fatal pulmonary embolism increased with age. In colonic operations there were no fatalities from embolism before the fifth decade of life, although the peak of the incidence of thromboembolism occurred in the seventh decade of life.

In thrombophlebitis, clotting results from injury to the vascular endothelium produced by mechanical or chemical trauma or by bacterial invasion. The clot is firmly attached to the vein and does not easily become detached as an embolus. Embolism may occur when a loosely adherent red or coagulation thrombus forms proximal to the fixed or firmly attached white thrombus. In phlebothrombosis, on the other hand, the clot is the result of alterations in the clotting tendency of the blood and venous stasis, hence is unassociated with inflammation of the vein wall. The thrombus is loosely adherent to the vein wall and may easily be detached and produce an embolus.

In recapitulation it may be stated that the general causes of thrombosis are: (1) slowing of the blood stream; (2) changes in the composition of the blood, and (3) trauma which may include a surgical procedure. Slowing of the blood flow has been considered as a very important causative factor. Changes in the composition of blood include alterations in the prothrombin time, clotting time, calcium value, sedimentation rate, platelet count, infection, and so forth. Wright has shown that the platelets begin to rise on the fourth day following a surgical operation and are most numerous on the twelfth postoperative day, and they fall back to normal on the twenty-first postoperative day. These phenomena apparently correspond with the clinical onset of postoperative thrombosis, although, according to Newburger, postoperative thrombosis may begin before the third postoperative day. Homans (23) believes that "life in bed, the reclining position, abdominal distention, enfeeblement of the circulation and elevation of venous pressure in the lower limbs, perhaps combined with muscular relaxation and atrophy of the legs" are the dominant etiologic factors. Hunter and his associates believe that the "common denominator in phlebothrombosis and pulmonary embolism is confinement to bed. The reason for going to bed is un-

experimental and clinical studies of intestinal motility and postoperative distention. He noted that the action of the small and large bowels was contrary; when the colon is motile the small intestine is quiet, and vice versa. Opiates, prostigmine, physostigmine, and acetylcholine derivatives stimulate the small, but inhibit the large bowel. Posterior pituitary extract and pitressin inhibit the small, but stimulate the large bowel.

*Postoperative ambulation.* The most provocative discussion on the use and abuse of bed rest was initiated by Dock. This discussion was aimed to undermine the present day ill conceived but well established foundations of bed rest as a therapeutic measure. It was shown that lying in bed is sometimes an inferior means of securing absolute rest than sitting quietly in a chair, because many patients are more restless in bed than they are in a chair. Studies of basal metabolic rates have shown that the energy exchange while sitting in a chair is not materially higher than that of a patient lying in bed. Lying in bed leads to impairment of the appetite, distention, constipation, prostatism with or without retention of urine, bed sores, loss of muscle tone with atrophy, loss of calcium from the skeleton with calcinuria and the formation of renal lithiasis, and also to depression of the morale. The use of the commode entails less discomfort and danger than does the use of a bed pan. Pulmonary embolism (which is discussed fully elsewhere in the text) is perhaps the most serious consequence of bed rest. Postmortem studies at the New York Hospital revealed that more people die from massive pulmonary embolism which is a direct result of complete bed rest than from many serious illnesses and from all the drugs combined.

It should be pointed out that until the era of Florence Nightingale the sick usually got up several times daily for elimination, and perhaps also for meals. The development of the profession of nursing has ushered in the era of complete bed rest with absolute quiet which is aided by the extensive administration of hypnotics and narcotics. As a result, the patient lies flat in bed and is guarded against moving by the solicitous nurse as well as by the medication. "As with all perversions from biologic normality, this too must be paid for by discomfort, invalidism, and death."

Early ambulation following intra-abdominal operations was first proposed by Ries in 1899, but this practice did not find acceptance until recently. The term early ambulation needs precise definition as some surgeons ambulate their patients on the day of the operation or on the first postoperative day, while other surgeons allow their

patients out of bed on the third or fourth postoperative days.

Leithauser stated that "as a result of getting patients out of bed on the first postoperative day and increasing their activity as tolerated, circulatory and pulmonary complications have been reduced to a minimum, intestinal function has been restored without enemas, and the period of morbidity and disability has been diminished 50 per cent or more." Leithauser reviewed 29 foreign articles comprising aggregate studies of over 15,000 patients who had been subjected to early ambulation and found only 3 definite instances of fatal emboli in this group of patients. He also reported his personal experience with 900 private patients.

Leithauser presented evidence gathered from published reports which showed that reflexes from the incision and traumatized areas have a definite relationship to the development of many avoidable complications. Immediately after an abdominal surgical procedure, as a result of reflex to the diaphragm, there occurs a diminution in vital capacity which gradually improves following the first postoperative day and becomes normal between the seventh and fourteenth postoperative days. "The extent and duration of the reduction in vital capacity bear a direct relation to the extent of the surgical procedure." Numerous investigators have "emphasized that pulmonary complications increase in direct proportion to the reduction and duration of reduction of vital capacity." About 90 per cent of primary postoperative pulmonary complications arise before the end of the fourth day while 50 per cent of these are established within 24 hours. Reflex phenomena also exert an effect on the vascular bed and the functional activity of the vital organs. Pathological reflexes to the vital organs (kidneys, liver, and so forth) and the vascular bed occur immediately after the abdominal incision is made and promote anoxia, incomplete metabolism, and faulty elimination. The intensity and the prolongation of these pathological reflexes increase the morbidity and complications. Early ambulation, deep breathing, and coughing exercises stimulate the circulation and respiration and hasten recovery by decreasing the deleterious reactions arising from the abnormal reflexes. Coughing exercises expel mucous plugs from the bronchial tree and are very beneficial in the presence of pulmonary complications. In the standing position the weight of the intra-abdominal organs lowers the diaphragm and thus facilitates the return of vital capacity to normal by allowing air to enter beyond the mucous plugs. From a study of the

literature and his own observations Leithauser concluded that early rising should be instituted during the first 24 postoperative hours when the vital capacity is at a low level; immediately after recovery from the anesthetic is the best time.

There occurred no eventration in the 900 of his personal cases. "The tensile strength of sutures is greater during the early postoperative period and healing is promoted through ambulatory activity." Early rising relieves postoperative distress, promotes rapid recovery, and returns the patient to work early. These aspects have special value in military practice. "The chief obstacle to early rising is fear and respect for tradition on the part of the surgeon and patient."

Nelson critically analyzed a series of 429 operations performed through 426 incisions of the anterior abdominal wall after which early ambulation was instituted. The majority of his patients walked the day of the operation or within the first 24 hours. Nelson is in substantial agreement with Leithauser's studies and conclusions. Nelson believes that early postoperative ambulation is a sound advance in surgery and recommends its universal adoption.

Andrus and Barnes listed the following as contraindications to early ambulation: (1) cardiac failure, (2) shock, (3) severe anemia, (4) cachexia, (5) hemorrhage, (6) the possible presence of thrombi and emboli, (7) peritonitis, (8) cholangitis, (9) pancreatitis, (10) liver infections, (11) potentially infected wounds, (12) copious tamponade, and (13) prolonged preoperative rest.

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erly patients requiring major abdominal surgery for cancer. They believe that the "interruption of a normal femoral vein is harmless."

Chemotherapy with heparin and dicumarol is on trial at the present time. These drugs, given alone or simultaneously, appear to be indicated for patients with a history of antecedent venous thrombosis or embolism. However, Fine and Starr believe that heparin and dicumarol are not dependable drugs for the prophylaxis of pulmonary embolism. De Bakey cautions editorially that these anticoagulant drugs may cause postoperative hemorrhage. Barker and his associates admit that dicumarol carries a "small risk of bleeding." Work is now in progress in Boston which deals with the beneficial effects of dicumarol employed postoperatively (1). The results are expected to be published soon.

*Poor risk patients.* Andrus and Barnes contributed an instructive article dealing with surgery in the poor risk patient. They discussed the cardiac, gastrointestinal, respiratory, hepatic, and metabolic aspects of this problem. They also discussed the newer knowledge concerning the administration of fluids, electrolytes, plasma protein, and vitamins. When vitamins are indicated in surgical patients, adequate preoperative and postoperative dosages (thiamine, 50 mgm.; riboflavin, 10 mgm.; niacin, 100 mgm.; ascorbic acid, from 500 to 1,000 mgm.; and vitamin K, 2 mgm.) should be administered.

It may here be interpolated that hypoproteinemia in surgery has received extensive studies in recent years. When a high protein diet cannot be ingested in hypoproteinemia, it is imperative to deliver an adequate protein supply to surgical patients by the parenteral administration of pure amino acids, casein hydrolysate, blood, plasma, or ascitic fluid.

#### PSYCHOSOMATIC MANIFESTATIONS

Menninger stated that the medical officer, more than the civilian doctor, is "faced with personality deviations expressed sometimes in behavior, sometimes in physical functional complaints, sometimes in frank psychiatric syndrome." He succinctly discussed the relative importance of psychiatric factors in 5 general groups of illness and the attitude of the medical officers toward these psychiatric factors. A medical officer who is ignorant of the patient's emotional factors handicaps his own efficiency and the patient's health. To a degree treatment will vary, depending on the medical officer's personal status; some develop a vindictiveness toward the soldier which they would never display in civilian life. It is not un-

common to hear a medical officer say "the bastard isn't going to get away with this" or "if I can't get away with it, by the gods, neither will you." General Menninger, in a spirit of constructive criticism, pointed out the errors observed in the medical and surgical wards and the ways and means to their elimination. It is important to learn to know and to appreciate the patient as well as his complaint and disease. The patient may not know the cause of his trouble but he knows how he feels, whereas the physician may know the cause but he does not know how the patient feels. The patient usually senses whether his physician is interested or is going through the motions. General Menninger's article should be read and reread by everyone interested in the psychosomatic aspect of medicine and surgery.

Shacter stated that psychosomatic symptoms of patients who consult the surgeon must neither be overlooked nor ignored. They are the expression of emotional disturbances manifested as organic complaints through the autonomic nervous system. Psychogenic symptoms may resemble those produced by organic and operable lesions. Patients who have a multiplicity of complaints and an operable lesion that is not responsible for all of their complaints should, for obvious reasons, be told of the nature of their complaints before surgical therapy is instituted.

Rosenblum discussed pruritus vulvae in which the psychogenesis of the disorder was that of hysterical conversion symptom. Becker believes that 90 per cent of pruritus vulvae or ani is functional in nature and that the remaining 10 per cent has an organic basis. He observed overactivity and oversensitivity in these patients. "Overactivity results in the formation of products of exhaustion. Oversensitivity results in exaggerated emotional reactions which increase the exhaustion." Rothman stated that thickening of the epithelium occurs as a result of chronic scratching and this epithelial change increases the susceptibility to pruritic stimuli, hence, the justification of local therapy for psychogenic vulval or anal pruritus. Thickening of the epithelium not only diminishes the threshold to physiological pruritic stimuli but it also causes inadequate stimuli, such as cold and the finest touch, to elicit a paroxysm of pruritus. Therefore, localized pruritus is regarded as both a psychic and a somatic problem.

Daniels stressed the importance of personality factors in the precipitation and recurrence of ulcerative colitis which is a recurrent, wasting, and, frequently, a fatal disease without an established etiology. In the majority, but not in all cases, the emotional factors are important and the gross



is separated from the sacrococcygeal fascia and removed. A lateral incision through the gluteal fascia in the line of the original incision is now made on either side. It is deepened into the fibers of the gluteus maximus and the fibromuscular flap thus created is turned medially and sutured to its fellow of the opposite side, in the midline. This fills in the area dorsal to the sacrum, eliminates the dead space, and furnishes an abundant blood supply to the base of the wound. The lateral flap slides medially over the edge of the sacrum and is sutured to the opposite lateral flap without tension. The skin is now easily approximated."

It is important to secure perfect hemostasis and to approximate the caudal end of the wound accurately. This operative procedure is especially applicable for primary closure of large uninfected pilonidal cysts or of those infected cysts that have been thoroughly drained prior to operation. The reviewer has successfully employed this operation with a slight modification, namely, the principle of delayed closure of the wound is utilized (51).

Small or medium sized pilonidal cysts can be eradicated and closed primarily without tension by simpler techniques, such as that employed by Gage. The application of the sponges over the wound to help obliterate the dead spaces is a good additional aid to all techniques of primary closure.

In military hospitals various primary closure techniques have been employed with variable success. This is evidenced by published reports and civilian testimony of competent observers like Frank H. Lahey.

Enucleation excision of the pilonidal cyst and sinus and primary closure with drainage as contrasted to excision en bloc is advocated by Bartlett. An oblique incision of the skin is made and the fat is closed from side to side as well as to the fascia in order to obliterate dead space. A small soft rubber drain is placed to the depth of the wound, which is usually removed on the first day of the operation. Bartlett believes that only "a wound of this region in which hemostasis is literally perfect should be left undrained." Valid objections may be raised to the use of a drain as a persistent draining sinus may result in some cases, as occasionally occurs following the Morter procedure.

Worthwhile partial closure techniques are those described by MacFee and Mutschmann and Mitchell. In these procedures the lesion is excised en bloc and the skin edges are sutured, without tension, to the sacrococcygeal fascia in the midline, an open area, from 0.2 to 0.5 cm. in width, being left between the skin edges for granulation and epithelialization. However, Bartlett has ob-

served instances of poor healing after this type of operation, that was associated with pain upon sitting and required secondary surgical treatment.

Recently, Brockbank and Floyd have reported favorably on the so-called marsupialization or saucerization operation which was first described by Buie a long time ago and was again discussed by him in a recent communication. In this procedure the roof and most of the sides of the cyst are removed but the floor which overlies the fascia is undisturbed. The skin edges of the wound are sutured to the edges of the cyst. The remaining cyst wall is said to undergo squamous metaplasia. Bartlett, on theoretical grounds not substantiated by his personal experience, questions the validity of the evidence for the claim that the remaining cyst wall will assume the characteristics of skin.

Immediate skin grafting following excision of the cyst and sinus bearing tissues apparently first performed by Scarborough, has been advocated by Weeks and Young. Intermediate or thick split thickness grafts are used. It should be pointed out that while this is an excellent surgical method it does not save duty hours because the grafted skin cannot usually withstand the strain incident to full military physical duty.

The choice of form of anesthesia employed in the surgery of pilonidal disease is of importance. Brockbank and Floyd are opposed to local infiltration anesthesia because it increases the incidence of complications and recurrences as well as the period of hospitalization. Forty-seven patients who had been operated upon under spinal anesthesia were hospitalized for 21.1 days after operation, while 116 patients who were operated upon under local anesthesia remained in the hospital for a period of 46.8 days. There were 6 severe infections following local anesthesia and none following spinal anesthesia.

The value of chemotherapy in pilonidal disease is discussed in the chapter dealing with chemotherapy.

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# ABSTRACTS OF CURRENT LITERATURE

## SURGERY OF THE HEAD AND NECK

### HEAD

Stralch, C. L., and McEvitt, W. G.: Total Avulsion of the Scalp. A Review of the Problem with Presentation of a Case of Skin Graft in Which Thrombin Plasma Fixation Was Used. *Occup. M.*, 1946, 1: 451.

Traditionally a woman's hair is her crowning glory. To suffer the irremediable loss of complete scalp is one of the most terrible of afflictions. A malignant fate seems to increase the disaster by visiting the misfortune on young women to whom physical attractiveness is a pearl beyond price.

While not rare, this accident is sufficiently uncommon that many experienced surgeons have never dealt with the condition. The treatment is that of a real emergency, and there is then no time for study. Therefore, it is not surprising that even recent case reports show the same errors that have been made by surgeons for a century. Few physicians have the opportunity to attend a second case.

Total avulsion involves complete separation of the entire scalp from the cranium.

Today complete scalping, as one would expect, is confined almost entirely to women. The scalp is usually considered to have five layers—skin, subcutaneous tissue, the aponeurotic layer, the subaponeurotic layer, areolar tissue—and the periosteum. The subaponeurotic layer is loosely woven.

The authors have included the history of scalping and the anatomy of the scalp as well as the mechanism of total avulsion of the scalp. The symptoms, physical signs, and subsequent course of the untreated injury are outlined.

The mechanism of total avulsion is by pull in an oblique direction. Rarely is any of the face below the eyes, or the neck below the hairline, affected. The scalp should be saved and may be utilized. It is extremely important also that the hair be rescued and preserved, as it makes the best possible kind of wig.

A case of complete avulsion is presented in which a successful graft was made at 1 major operation and 2 minor ones. A thick dermatome graft was used, which was caused to adhere to the skull by fibrin fixation. The total period of hospitalization was 78 days. It is the authors' opinion that this represents the best modern management of the denuded skull.

For the wound seen immediately they suggest a method of splitting the scalp and using the outer layers as a free graft, which they hope may in the future provide victims of total avulsion with a hair bearing coverage for the skull. The application of blood plasma and thrombin topical solution seems an excellent method of fixation.

Plant managers should insist that women working around machinery protect their hair with hair nets.  
HARRY W. FINK, M.D.

Giunchi, G.: Temporomaxillary Actinomycosis Caused by Anaerobic Actinomycetes of the Wolff-Israel Type, and Cured by a Combination of Sulfa Drugs and Roentgen Therapy (Attinomicosi temporo-mascellare, da attinomicete anaerobio del tipo Wolff-Israel, guarita con trattamento combinato sulfamidico e roentgenterapico). *Policlinico*, sez. prat., 1946, 53: 354.

The author treated temporomandibular actinomycosis in an 18 year old student with sulfamethylthiazole followed by roentgen therapy. The patient had a voluminous tumefaction in the right masseter, parotid, and temporal regions with an indistinct outline and of hard elastic consistency; there was also a fistula present. The alveolar portion of the lower jaw was intact and the regional lymph glands were normal. A culture of aspirated fluid disclosed anaerobic fungi of the Wolff-Israel type. Complement deviation tests were positive. The intradermal reaction with actinomycotic antigen was positive.

No amelioration could be obtained with potassium iodide. Three grams of sulfamethylthiazole were administered daily for 4 days, and 2 gm. per day were given on the following 7 days. After a 5 day interval the entire course was repeated. The tumefaction markedly diminished in size, the secretion disappeared, and a cicatrization of the fistula took place. Bacteriologic examination of aspirated fluid gave negative results; the pains and trismus disappeared.

Four months later a small tumor was still present, but bacteriologic examination gave negative results.

Polyneuritis, which developed in the course of the sulfa drug administration, was attributed to the medication, and induced the author to abstain from the further employment of sulfa drugs. A dosage of 1,200 r. of x-rays were given and under the influence of this treatment the tumor disappeared completely. A check-up 3 years later showed no signs of recurrence.  
JOSEPH K. NARAT, M.D.

Morales, E.: Osteomyelitis of the Sphenoid Bone (Osteomielitis del esfenoides). *Rev. otorr.*, 1946, 6: 1.

The author reports a clinical observation of a case of osteomyelitis of the sphenoid bone in a 14 year old boy who on February 15, 1943 had symptoms simulating those of influenza, high fever, pain on swallowing, and left otalgia. On the following day a small peritonsillar abscess was observed on the left



side; this was incised and a purulent secretion appeared. During the following days the patient's condition became worse; there was inflammatory edema involving the left half of the skull, neck, and face with symptoms of meningism, rigidity of the neck, Kessig's and Brudzynski's signs, papillary edema of the left side, and a leucocyte count of over 14,000.

A diagnosis of thrombophlebitis of the cavernous sinus, lateral sinus, and left jugular vein was made and the patient was given 8 gm. of sulfa drugs daily for 10 days. A large tumefaction at the level of the left parotid gland was incised but no pus was found. There were 2 sequelae after the intervention: a facial paresis and a salivary fistula.

Three months after the patient was first seen he had a crisis of the epileptic type with loss of consciousness. No abnormality could be found after x-ray examination of the skull. Seven months after the symptoms began the local edema increased to extend to the eyelids and the patient had exophthalmos.

Again the local symptoms regressed after sulfa drug therapy but later the edema and pain localized in the right temporal region and occurred in the superior eyelid of the same side. The tumefaction was incised and a periostitis without pus was found. For the next 8 months there was persistence of the fronto-temporal edema, exophthalmos, and fistula of the left external orbital angle. The pus cultured was positive for the staphylococcus aureus. Occasionally bone fragments were drained through the nose and some of the secretion was eliminated posteriorly to the pharynx.

After the symptoms persisted for 1½ years the patient was given 500,000 units of penicillin. Later he was given a total of 5 million units of penicillin. Definite regression of the edema and exophthalmos was then observed. WILLIAM E. RICKETS, M.D.

Gerry R. G., and Sangston, R. E.: Congenital Mandibular Deformities in Newborn Infants. *Am. J. Orthodont.*, 1946, 32: 439.

Congenital mandibular deformities in newborn infants have been frequently found but infrequently described. These deformities have been mentioned in the pediatric literature but not in the dental literature. Because of the possible confusion between these deformities and dislocation or fracture of the mandible, the authors present a small series of cases to illustrate how mandibular deformities may occur.

Deviation of the jaw was found to be present in about 20 per cent of the newborn infants which they observed. The deformities were due to intrauterine pressure, and not to a genetic disturbance, since only 1 of identical twins had this defect.

By reconstructing the position of comfort, it is often possible to illustrate the position in utero; it is also important to search for other congenital defects which might require early treatment. In all cases the deformities caused no difficulty in nursing or feeding and they were corrected spontaneously by the end of the tenth week. NOAH D. FABRICANT, M.D.

Rushton, M. A.: Unilateral Hyperplasia of the Mandibular Condyle. *Proc. R. Soc. M., Lond.*, 1946, 39: 431.

Hyperplasia of the mandibular condyle was first described in 1836 and up until 1936 about 17 cases had been reported. Several have since been added and this report includes 3. The condition makes itself apparent sometime between the ages of 10 and 30. Growth of the mandible occurs from the condyle, the articular surface of which is covered by fibrous tissue with precartilaginous tissue and cartilage and beneath this bone in the process of ossification is found. The formation of cartilage and its replacement by bone normally stops at about the age of 20.

The author reviews the various cases already recorded and presents the opinion that the condition is due in most instances to an abnormal continuance of growth at the condylar surface which leads to the formation of an elongated narrow neck so long as the natural process of remodelling of the neck persists. The coronoid process does not become enlarged. The chin projects forward and to the opposite side, which causes malocclusion of the teeth. The etiology is not known.

The most successful treatment has long been known to be excision of the condyle. This could be carried out as soon as the progressive nature of the deformity is definite, but condylectomy at a very early stage might make the operative side of the jaw permanently too short. JOHN R. LINDSEY, M.D.

Papper, E. M., and Rovenstine, E. A.: Anesthetic Management in Reconstructive Surgery of the Mandible. *Am. J. Orthodont.*, 1946, 32: 433.

Operative procedures upon the mandible pose special problems in anesthesia in direct proportion to the complexity of the surgical manipulations. Replacement of mandibular defects by bone grafting is difficult for surgeon and anesthetist alike.

The authors elaborate upon the principles concerned in anesthetic management and describe the results obtained in a series of 67 patients whose mandibular disabilities were traumatic in origin. Thirty-nine patients were anesthetized with nitrous oxide oxygen anesthesia aided by curare; 14 by the ether nitrous oxide sequence, 10 with ether and nitrous oxide, followed by scopolamine in the postoperative period, and 4 with pentothal (cocaine topical). All of the anesthetics were given intratracheally. NOAH D. FABRICANT, M.D.

## EYE

Sorsby, A., and Symons, H.M.: Amniotic Membrane Grafts in Caustic Burns of the Eye (Burns of Second Degree). *Brit. J. Ophthalmol.*, 1946, 30: 337.

The authors discuss the use of grafts of human amniotic membrane in the treatment of caustic burns of the eye.

The main object, with this form of therapy, is to keep the inflamed surfaces apart. The ultimate

damage from caustic burns is usually greater than the immediate reaction. In the majority of cases, the burn is of second degree; usually, a localized superficial conjunctival lesion and a variable superficial corneal lesion are present. Neutralization of the caustic is of little value but excision of the damaged conjunctiva has been found valuable.

Prior to insertion of the graft, the eye is treated with penicillin—one drop of a concentration of 2,500 units per cubic centimeter every minute for a period of 10 minutes.

Dry human amniotic membrane is then folded to the correct size, in several layers. Silk is passed through each corner of the graft and through the bulbar conjunctiva, to suture the graft into place without covering too much of the corneal surface.

After 48 hours, when the bandage is removed, the graft is no longer visible, and it may be observed that the graft has become transparent and formed a layer over the conjunctival surface. The sutures are removed on the third or fourth day, and the eye is left open.

The authors conclude, from their experience in the cases of 30 patients with caustic burns of the eye which were treated by this method, that recovery is more rapid, and there are fewer corneal and conjunctival complications and fewer sequelae if the operation is performed immediately or, at most, 1 or 2 days after the injury.

JOSHUA ZUCKERMAN, M.D.

Duke-Elder, Sir S.: *The Nutritional Aspects of Ophthalmology*. *Irish J. M. Sc.*, 1946, No. 246, 177.

While a great volume of material on nutrition has appeared in recent years, commercial claims have often outstripped laboratory findings, and while extremes of starvation have been noted incident to the recent war it is the milder changes of a nutritional deficiency which have the more practical importance in normal life.

The only vitamins of importance ophthalmologically (as far as we yet know) are A, B, C, and D. The two ocular manifestations of Vitamin A deficiency are xerophthalmia and night blindness. The first entity was recognized, about the fifteenth century before Christ; but its cause was unknown; its relation to lack of Vitamin A was proved only after World War I. Recent work indicates that other factors besides Vitamin A are important in dark adaptation and that in many cases intake of this vitamin will not correct a night blindness.

The importance of riboflavinosis in causing keratitis has been grossly exaggerated by some authors. It is to be seriously considered only when newly formed vessels invade the cornea all around the limbus in both eyes, and the condition clears promptly on riboflavin therapy. The condition is extremely rare.

In spite of the reduction of Vitamin C found in cataractous lenses, no true causal relationship has been demonstrated.

The effect of avitaminosis on the central nervous system has been brought out during the recent war by the effect on those returned from German and Japanese prison camps where they had subsisted on a near starvation diet. A central scotoma develops, followed by a pallor of the optic disc but not complete blindness. If proper diet is obtained within 6 months from the onset most of the patients recover. The exact deficiency responsible is unknown although it is probably some part of the B vitamin.

It is suggested that if a profound state of avitaminosis can produce an optic neuropathy leading to optic atrophy or encephalopathy, minor subclinical degrees of deficiency may not be without effects in producing mental fatigue, irritability, apathy, depression, and neurasthenia. While the final answer is far in the future, it seems certain that eventually the nutritional basis of metabolic processes will be found to implicate the activity of every cell in the body more than is suspected today.

WILLIAM A. MANN, M.D.

Mann, I.: *Exophthalmic Ophthalmoplegia*. *Am. J. Ophth.*, 1946, 29: 654.

On the basis of experimental studies on the production of exophthalmos an attempt has been made to differentiate clinically between the effects produced by excess pituitary thyrotropic hormone and those caused by excess of thyroxine. Three sets of eye signs must be regarded: namely, (a) those due to overaction of unstriated muscle (lid retraction and exophthalmos abolished by anesthesia), (b) evidence of weakness of striped muscle (ophthalmoplegia), and (c) signs of increase in bulk (proptosis, chemosis, and edema of the lids). General changes, such as those in the basal metabolic rate and in weight, must also be considered. The possible action of the central nervous system through the hypothalamic structures as the stimulant or depressor of the pituitary gland must also be borne in mind.

In thyrotoxic ophthalmoplegia there is weakness of the extraocular muscles, with retraction of the upper lid and without any increase in the orbital contents. In thyrotropic exophthalmos, on the other hand, it is considered that there is ophthalmoplegia as well as proptosis and the eyeball cannot be pressed back nor moved freely within the orbit. There may be complication of the two types, but from a clinical standpoint it is perhaps simplest to consider lid retraction as a sign of excess thyroxine and defective eye movements as a result of excessive thyrotropic hormone.

The series of cases reported in this article were studied in an attempt to disentangle the parts played by the thyroid and pituitary glands, and the author has divided the 18 cases into various groups, as in some cases there was an overlapping of the two types of conditions. The following three groups are described:

1. Primary deficiency of thyroxine with compensatory excess of thyrotropic hormone secretion (4 cases).

2. Primary excess thyroxine as the initial symptom followed by thyroid atrophy or removal, and replacement with excess thyrotropic hormone (10 cases).

3. Excess thyroxine and excess thyrotropic hormone arising simultaneously (4 cases).

The cases are reported in detail. The most interesting feature of the treatment was the marked improvement following the use of thyroid extract in groups 1 and 2. Of course, thyroid cannot be used in the patients in Group 3, who must still be treated symptomatically. In addition to the thyroid therapy, tarsorrhaphy was found useful in treating some of the cases in Groups 1 and 2.

Ida Mann has made a very valuable contribution to the therapy of exophthalmic ophthalmoplegia.

WILLIAM A. MANN, M.D.

**Siniscal, A. A.: Oculoglandular Tularemia.** *Am. J. Ophthalm.*, 1946, 29: 698.

The author reports 3 cases of oculoglandular tularemia with a typical clinical picture in each. In each case a domestic animal was thought to be the agent of transmission.

The article includes an excellent summary of the literature on the subject. Emphasis is made on the importance of the differential diagnosis from other forms of oculo-glandular pathology and the place of the blood agglutination test in tularemia. Ordinarily the latter is not positive until after 10 days. Although fatal in many animals, tularemia of all forms is said to be fatal in only 5 or 6 per cent of the cases in human beings.

Treatment of oculoglandular tularemia consists in the local use of mild germicidal preparations, Foshay's serum, artificial fever therapy, and convalescent serum in severe cases. Streptomycin has been reported to be effective against the disease in laboratory animals.

WILLIAM A. MANN, M.D.

**Roenne, G.: Local Treatment of Intrabulbar Infections. Treatment of Staphylococcal Panophthalmitis by the Intrabulbar Injection of Penicillin.** *Brit. J. Ophthalm.*, 1946, 30: 405

Although the author's investigations dealt with only a single form of bacterium it may be assumed that penicillin has the same bactericidal action on other microbes usually encountered in infected perforating lesions of the eye. Moreover, in sufficiently large doses the effect of penicillin is practically unlimited even for the most intense infections. The intrabulbar injection of penicillin results in a few advantages not obtained with general treatment; for example, the bactericidal concentration of penicillin is maintained for a long period of time (from 16 to 24 hours); only small quantities of penicillin are necessary; and the penicillin will attain a satisfactory concentration in the vitreous, which result will not follow general penicillin treatment.

Roenne concludes that for intrabulbar, especially intravitreal inflammations, the injection of penicillin into the vitreous is the best form of therapy to date.

In therapeutic concentrations of between 100 and 500 Oxford units it is practically harmless and is extraordinarily effective compared with injection of other substances, such as chloramine-T, and with other forms of their application. The effectivity is directly proportional to the concentration of penicillin, the result being dependent only on the number of bacteria in the eye and not on the interval between the inoculation and the treatment.

JOSHUA ZUCKERMAN, M.D.

**Cutler, N. L.: Transplantation of the Human Vitreous; A Preliminary Report.** *Arch. Ophthalm., Chic.*, 1946, 35: 615.

This is the first published report on the transplantation of human vitreous for the correction of vitreous opacities. Previously, efforts have been made to produce a clearer medium by injecting normal salt solution and air. Three cases were treated in which there was a large amount of unabsorbed vitreous hemorrhage; 2 of the cases were traumatic and 1 was spontaneous. There was good light projection and the intraocular tension was normal.

A small scleral incision with the cataract knife is made in the equatorial region after a preliminary 0000 silk mattress suture is effected. An 18 gauge needle on a 5 c.c. syringe is introduced directly into the vitreous and approximately 1.5 c.c. of vitreous are withdrawn. Approximately 2 c.c. of clear vitreous from a freshly enucleated eye are then injected with a syringe through the needle and the suture is tied.

In 2 of the 3 cases the procedure was successful. In 1 case the visual acuity improved from light perception and projection to 20/60 with correction; in the second the improvement was from light perception to 20/30 with correction; and in the third the result was a failure and it was believed that the vitreous was injected behind the retina because of detachment of the latter.

From his experience with this procedure the author believes that from 1.5 to 2 c.c. of vitreous are the maximum which can be withdrawn from the recipient eye. The blood group does not appear to be significant. The pathological vitreous appeared to be more fluid than normal but it is not known whether this was caused by the transplanted vitreous. There was a moderate reaction after the transplantation but no foreign protein reaction. The tension in all 3 cases returned to normal in a short time and remained so.

It is believed that this method offers new possibilities in the surgical treatment of the vitreous.

WILLIAM A. MANN, M.D.

**Elwyn, H.: Heredodegenerative Diseases of the Retina. An Attempt at Classification.** *Arch. Ophthalm., Chic.*, 1946, 35: 662.

Abiotrophy, or heredodegenerative disease, of the retina is classified by the author under the diseases of the central nervous system characterized by a specific loss of neural tissue as a result of hereditary influences. He differentiates these from the heredode-

constitutional diseases in which there is a hereditary vital defect but no progressive loss of tissue so that the disease remains stationary.

Heredodegenerative diseases of the retina may occur:

1. As primary disease of certain retinal elements (retinitis pigmentosa, heredodegeneration of the macula).

2. In association with another similar disease of the retina, such as macular degeneration associated with degeneration of the peripheral neuroepithelium.

3. In association with hereditary diseases of the central nervous system (Laurence-Moon-Biedl syndrome).

4. As part of a hereditary disease of the central nervous system (amaurotic familial idiocy).

5. As a part of a widespread systemic disease involving many organs (Niemann-Pick disease, tuberous sclerosis).

These conditions may also be classified according to the retinal elements primarily involved and the following classification is given:

A. Originating in the elastic layer of Bruch's membrane.

1. Disciform degeneration of the macula (Kühnt-Junius type)

2. Angioid streaks in the fundus

(a) Occurring alone

(b) Occurring in association with pseudoxanthoma elasticum (Grönblad-Strandberg syndrome)

B. Originating in the pigment epithelium

1. Hyaline or colloid bodies (drusen) of the basal layer of Bruch's membrane

C. Originating in the neuroepithelium

I. In the central, or macular area

1. Heredodegeneration of the macula, including the infantile, juvenile, adult, presenile, and senile types, occurring (a) alone, or in association with (b) degeneration of the peripheral neuroepithelium, (c) atrophy of the optic nerve, (d) color blindness, and (e) mental deterioration

II. In the extramacular neuroepithelium

1. Retinitis pigmentosa, occurring (a) alone, or in association with (b) degeneration of the macula, (c) color blindness, (d) deafness, (e) mental deterioration, (f) the juvenile type of amaurotic family idiocy, and (g) the Laurence-Moon-Biedl syndrome.

III. Heredoconstitutional diseases of the neuroepithelium

1. Retinitis punctata albens  
2. Congenital night blindness without changes in the fundus  
3. Congenital night blindness with grayish white discoloration of the fundus (Oguchi's disease)  
4. Color blindness

IV. Heredodegeneration of doubtful origin but standing in some relation to degeneration of the neuroepithelium

1. Gyrate atrophy of the choroid and retina

2. Choroideremia, a heredoconstitutional disease

D. Originating in the ganglion cells

1. Infantile type of amaurotic familial idiocy (Tay-Sachs disease), affecting only the ganglion cells

2. Juvenile type of amaurotic familial idiocy, involving the neuroepithelium in addition to the ganglion cells

3. Niemann-Pick disease

E. Involving the nuclear layers

1. Peripheral cystoid degeneration in senile and presenile eyes

2. Widespread cystoid degeneration, forming the basis for rupture of the retina with hole formation and consequent retinal detachment

3. Retinitis circinata

F. Involving the nerve fiber layer

1. Tuberous sclerosis, a widespread heredo-degenerative disease, causing the production of abnormal cells and tumors in this layer.

WILLIAM A. MANN, M.D.

## EAR

Shambaugh, G. E., Jr., and Juers, A. L.: *Surgical Treatment of Otosclerosis; A Preliminary Report on an Improved Fenestration Technique. Arch. Otol., Chic., 1946, 43: 549.*

The two year hearing results of the fenestration operation may be considered the permanent hearing results.

Experimental studies of the fenestration operation in the monkey have brought out certain factors that influence the osteogenesis tending to close the fistula. The application of these factors to the human operation has reduced the incidence of failure due to bony closure to less than 5 per cent in patients tested after two years.

The adoption of features to improve the mobility of the tympanomeatal skin flap between the tympanic membrane and the fistula has increased the average number of decibels gained from 28 to 30.

JOHN F. DELFII, M.D.

## NOSE AND SINUSES

Weille, F. L.: *The Problem of Secondary Frontal Sinus Surgery. Ann. Otol. Rhinol., 1946, 55: 372.*

Weille reviews the problem of secondary frontal sinus surgery on the basis of experiences with 276 cases of frontal sinus conditions treated by surgery. A total of 862 operations were performed upon the nasal cavities, sinuses, and cranium, including plastic and brain procedures. Many of these operations

were done outside of as well as in the Massachusetts Eye and Ear Infirmary. Of these, 447 were done directly or externally upon the sinuses. Some of the patients were referred to the Infirmary as a last resort; 95 had more than 1 external operation on one or both frontal sinuses. The highest number of operations on 1 patient was 9.

Aside from the deformity which it produces, the obliterative operation results in a not unmixed blessing. Thirty-three of 123 patients treated by this method required further frontal surgery. The repair of the deformity required an average of about a year in 71 patients. The longest time required for such repair was 5 years and 3½ months. Only 29 per cent of the 276 patients had no osteomyelitis and multiple nonobliterative operations (totalling 77) on the frontal sinus or sinuses.

A basic knowledge of applied surgical anatomy, and a fundamental understanding of epithelial, connective tissue, and bone responses in wound healing in the frontal region are helpful in evading repeated frontal operations. Simple closure of the nasofrontal surgical opening is a paramount cause for the necessity of secondary frontal sinus surgery. Some surgical methods for dealing with this problem are outlined.

The avoidance or simplification of surgical methods in the treatment of frontal sinus disease may be greatly aided by chemotherapy, especially with penicillin. However, chemotherapy is not a substitute for surgical fundamentals. Only 1 death occurred in the series after sulfadiazine and penicillin were used.

NOAH D. FABRICANT, M.D.

## MOUTH

Gaston, E. A., and Tedeschi, C. G.: Adenolymphoma of the Parotid and Submaxillary Salivary Glands. *Ann. Surg.*, 1946, 123: 1075.

Tumors composed of a combination of epithelial and lymphoid tissue arising in or near the parotid gland and occasionally in the submaxillary salivary gland have been reported with increasing frequency. The terminology of these tumors is confused by the fact that they have been reported under a number of different names, of which the following may be enumerated: papillary cystadenoma lymphomatousum, cystadenoma lymphomatousum, adenolymphoma, papillary adenolymphoma, papillary cystadenoma in the lymph glands, branchiogenic cystadenolymphoma, branchiogenic adenoma, cylindrocellular branchiogenic adenoma, oncocytoma and Warthin's tumor.

This varied nomenclature is, in part, a reflection of the numerous attempts that have been made to account for their origin. From a review of the literature and a study of the cases presented it is evident that not all tumors having this same fundamental structure are identical in either histological pattern or clinical behavior. Thus, a group of tumors exists and it is the purpose of this communication to attempt to clarify the nomenclature

by presenting a working classification based on morphology and clinical behavior. Four new cases are presented, 1 of which is malignant.

Two cases of papillary cystadenoma lymphomatousum of the parotid salivary gland and 1 case of a purely cystic variety of the same tumor are presented. These are rare tumors and occur 4-5 times more frequently in men than in women.

The recorded theories of the histogenesis of these tumors are reviewed. The authors agree with Warthin that they probably arise from epithelium of the embryonic pharyngeal endoderm or upper respiratory tract displaced to the region of the parotid gland.

Papillary cystadenoma lymphomatousum and its histological variants are probably always benign. The results of surgical excision are excellent.

A morphologically and clinically malignant tumor of the parotid gland consisting of a combination of glandular and lymphoid tissue is presented. Its histogenesis is discussed.

A classification of adenolymphomatous tumors of the parotid and submaxillary regions is suggested.

JOHN F. DELZEN, M.D.

Archer, W. H., and Morris, R. D.: A Survey of Oral Carcinoma at the Columbia-Presbyterian Medical Center. *Am. J. Orthodont.*, 1946, 32: 333.

The authors review 203 histories of oral carcinoma collected during the past 25 years at Columbia-Presbyterian Medical Center. The lesions occurred in the tongue, floor of the mouth, cheek, palate, and alveolar gingivae. Eighty-five per cent occurred in males, and 78 per cent were found in patients between 45 and 74 years of age. Statistics showed an apparent predisposition in individuals of Irish extraction and a lessened tendency in negroes. Thirty-two per cent of the lesions on the anterior tongue were associated with syphilis; 15.8 per cent were associated with leucoplakia, 11 of these patients also having syphilis. Smoking was found to be negligible as an extrinsic predisposing factor. Fifty-seven per cent of the patients gave no evidence of any of the possible contributing factors, such as leucoplakia, trauma, and irritation. A five year follow up was possible in 135 cases. Surgical treatment was given in 25, radiation therapy in 101, and a combination of the two, in 20. The five year survival rate was 23 per cent and did not vary according to the location of the primary lesion.

JOHN R. LANDSAY, M.D.

## PHARYNX

Hollender, A. R.: The Nasopharynx. A Study of 140 Autopsy Specimens. *Laryngoscope*, 1946, 56: 181.

The primary objective of this article is to record the pathological findings in 140 autopsy specimens of the nasopharynx.

The anatomy, histology, and pathology are discussed, and the pathological findings in 140 autopsies are tabulated. There were 24 cases of pulmonary tuberculosis among the total number and 18 of

these gave definite gross or microscopic evidence, or both, of tuberculosis of the nasopharynx.

As far as lymphoid hyperplasia of the nasopharynx is concerned, this study revealed the frequent incidence of hyperplasia of the nasopharyngeal or of the tubal tonsils, or both, in older persons, even in the sixth or seventh decades of life.

While 10 pharyngeal bursae were found among the 140 specimens, histological examination of several specimens revealed the fact that the characteristic symptoms of pharyngeal bursitis may be simulated by an inflammatory or infectious process in the median recess.

JOHN F. DELPH, M.D.

Nelvert, H., Pirk, L. A., and Engelberg, R.: Late Secondary Tonsillar Hemorrhage; Studies of Ascorbic Acid. *Arch. Otolaryng.*, Chic., 1946, 43: 563.

Two comparable series of patients undergoing tonsillectomy were studied. The plasma levels of vitamin C of the control series were determined before and after operation. The preoperative concentration of ascorbic acid was subnormal in more than half of the patients and there was a decrease in the vitamin C content postoperatively in the majority of those whose original values had been normal. Most of the hemorrhages occurred in the patients with vitamin C deficiency. The patients of the second series were saturated with ascorbic acid, and in these the incidence of hemorrhage was significantly reduced.

The patients of both series received liberal amounts of acetylsalicylic acid. Since hypoprothrombinemia caused by salicylate has been shown to be one of the most important etiologic factors of secondary tonsillar bleeding, the beneficial results observed with ascorbic acid were thought to be indicative of a protective effect exerted by this vita-

min against drug-induced prothrombinopenia. Experiments carried out in this direction bore out this suspicion. Evidence is presented that vitamin C prevents salicylate-induced hypoprothrombinemia. This effect is believed to be due to the detoxifying action of ascorbic acid.

In a subsequent report the results attending the combined administration of vitamins C and K will be presented.

JOHN F. DELPH, M.D.

## NECK

Dargent, M., Guinet, and Bonniot, R.: Benign Attacks of Goiter and a Severe, Heterogenous Type of Cancer. Clinical and Pathogenic Considerations (Poussées goitreuses bénignes et cancer hétérogène grave. Réflexions cliniques et pathologiques). *Presse méd.*, 1946, 54: 305.

Brief case histories are given of patients in whom the development of a colloid and apparently involuntary type of goiter followed the development of a cancerous condition. In 1 patient the malignant growth proved to be an achromatic nevoid cancer, in another, an atypical epithelioma of the breast; in the third, a recurrent spinocellular epithelioma following a Wertheim operation, and in the fourth, an atypical epithelioma of the breast which flared up again locally after removal of the goiter.

The author believes that this succession of cases with such an association of goiter and carcinoma is more than a coincidence and suspects the presence of cancerogenic (endogenous or exogenous) thyrotropic substances in these patients, which act as a chronic toxic stimulus on the thyroid gland. However, by this supposition the author does not mean to attack the commonly held conviction that the thyroid gland exercises a restraining influence on cancer.

JOHN W. BRENNAN, M.D.

# SURGERY OF THE NERVOUS SYSTEM

## BRAIN AND ITS COVERINGS; CRANIAL NERVES

Robertson, E. G.: A Method of Encephalography. *Surgery*, 1946, 19: 810.

As any neurological surgeon realizes, encephalography by the usual lumbar puncture method may on occasion fail completely in its results, although there is no obstruction to the passage of either air or fluid in the posterior cranial fossa. According to Robertson, this disappointing outcome of a procedure which may be fruitless and distressing to the patient may be obviated by definite positioning of the head during the procedure, so that with amounts as small as 25 c.c. of oxygen the ventricles may be filled, or the subarachnoid spaces and basilar cisterns well outlined in a selective manner.

The author uses filtered oxygen and the two-needle method, and cautions that at all times the gas must be introduced slowly. His patients are given omopon,  $\frac{1}{2}$  gr., and scopolamine hydrobromide, from 1/150 to 1/100 gr., if adults, and children receive either paraldehyde rectally or ether inhalation. During the introduction of the gas the patient sits with the head positioned in front of the x-ray screen. Since the injected gas rises against gravity to seek the highest level in the fluid spaces about the upper spinal cord, the patient's neck should be fully flexed when the introduction of gas is begun, so that there may be maximum filling of the cisterna magna and the subarachnoid spaces dorsal to the cervical cord. Then, with gradual extension (dorsiflexion) of the neck, the gas will enter the fourth ventricle and aqueduct when the angle of extension is from 90 to 80 degrees. Serial films may then be taken as the further introduction of gas and further extension of the neck proceed slowly. According to the author, gas usually enters the lateral ventricles at about the stage of 60 degrees of extension. The volume of gas in the ventricles increases progressively as the head is dorsiflexed, and is maximal when the head is erect. If, in the beginning, the patient's neck is dorsiflexed, the gas rises anterior to the cervical spinal cord to enter the subarachnoid spaces anterior to the medulla and to pass, at higher levels, into the basal cisterns.

Detailed instruction is given for the exact positions according to the angles of flexion and extension of the neck for selective filling of the ventricular system, the various basilar systems, the cerebral subarachnoid spaces, and the fluid filled spaces of the posterior fossa.

JOHN MARTIN, M.D.

Robertson, R. C. L., and Peacher, W. G.: The Management of Late Head Injuries. *Ann. Surg.* 1946, 124: 40.

A report is made of the experiences with tantalum in the repair of 254 cranial defects. The great ma-

jority of the patients were those with craniocerebral injuries, although a few had other cranial conditions requiring bone removal.

A one stage, operative procedure is recommended, with fashioning of the tantalum plate at the operating table. In traumatic cases, the dura has frequently been opened to remove cerebrodural or cortical scars, and, frequently, metallic foreign bodies. Tantalum foil has been used to cover the brain in cases in which the dura has been entered. It is believed that this may overcome further meningocerebral cicatrices.

All of the patients were subjected to pneumoencephalography previous to the operative procedure, in order that the presence of ventricular shift, porencephaly, internal hydrocephalus, and other conditions which would facilitate the operative procedure could be determined.

The post-traumatic syndrome was not encountered as frequently in the severe, penetrating gunshot wounds as in the milder cases of concussion.

Various medications were tried in the treatment of the post-traumatic symptoms of headache and dizziness, but with very little improvement in the results.

It was concluded that pneumoencephalography offers very little relief from post-traumatic head pain. It had been advocated as a therapeutic measure previously.

It was concluded that there was no specific medical or surgical treatment for the numerous manifestations of the post-traumatic syndrome. Intelligent, judicious management, with reassurance, early ambulation, mild sedation as indicated, and an intensive reconditioning program have given more favorable results than any other methods employed.

HOWARD A. BROWN, M.D.

Verneti, L.: The Behavior of the Hematological Picture in *Commotio Cerebri* (Sul comportamento del quadro ematologico nella commozione cerebrale). *Minerva med.*, Tor., 1946, 1: 134.

Ten cases of *commotio cerebri* are reported. In each case a blood study was made at the time the patient entered the hospital, and followed by subsequent daily examinations. Only such cases are included in this report in which the clinical symptomatology and subsequent course left no doubt as to the diagnosis of *commotio cerebri*, and excluded such possibilities as contusion or compression. In 6 instances the roentgenographic examination evidenced nondepressed fractures of the vault or of the base of skull; in 3 there was a simple condition of *commotio cerebri*, uncomplicated by cranial lesions. The remaining patient was not examined with the x-rays.

The initial blood examination, made in every instance within 12 hours after the injury, showed a variation of from 10,000 to 14,000 leucocytes; in 2

cases the corresponding counts were 21,400 and 21,600, respectively. In the following days the white count varied from case to case. In some instances the count returned to normal within 3 days; in others the count increased to attain its peak after 6 or 8 days. In 2 instances death occurred after 36 and 12 hours, respectively, and in these the count rose steadily up to the very end. A diminution in the number of eosinophils and a lymphopenia amounting to about a half of the usual count was constantly noted in these cases. In some cases a few immature elements of the myeloid series appeared.

The author believes that there is a center somewhere in the brain stem which is concerned in the regulation of the cytologic composition of the blood, particularly as regards the behavior of the white cell count; that this is the part of the brain concerned in commotio cerebri; and, therefore, that the behavior of the white cell count may be used in the prognosis in cases of uncomplicated commotio cerebri.

JOHN W. BRENNAN, M.D.

Ingraham, F. D., and Scott, H. W., Jr.: Craniopharyngiomas in Children. *J. Pediat.*, St. Louis, 1946, 29: 95.

This excellent article deals with the experience of the authors with 16 children who were treated for craniopharyngioma at the Children's Hospital and Peter Bent Brigham Hospital in Boston during the period from 1932 to 1945. Thirteen per cent of the reported intracranial tumors in children are craniopharyngiomas, and among the 2,000 verified intracranial tumors in the Cushing series, 4.6 per cent were such tumors.

After a clear description of the embryology and histological types of these tumors, the authors discuss the pathological physiology of craniopharyngiomas according to the four main disturbances which they produce: visual changes, intracranial hypertension, hypophyseal disorders, and hypothalamic dysfunction. They give 2 detailed case histories from their own files, and discuss the diagnosis of these tumors, a generally not too difficult process, which is based directly upon the physiological disturbances just mentioned.

Since these tumors are benign in nature, theoretically, at least, it is altogether logical that they should be treated by surgical means, and the results of the authors as well as of others who have had experience with a large series bear out this belief. Complications of surgery may arise from the leak of the highly irritating cyst fluid into the general ventricular system, and the persistent tendency toward arterial hypotension and collapse during and after surgery which must be combated with the proper administration of whole adrenal gland extracts. In those patients with long survival periods following the original surgical treatment but with recurrence, reoperation is the method of choice. When surgery has been tried but recurrence has been rapid, it may be safest and more effective to administer roentgen therapy to the tumor.

JOHN MARTIN, M.D.

Luft, R.: The Treatment of Cushing's Syndrome. *Acta med. scand.*, 1946, 124: 227.

It is the author's opinion that the syndrome commonly called Cushing's syndrome is not due primarily to the more or less typical cytological change in the pituitary gland, with occasional actual basophil adenoma formation, but rather that the disease is due to adrenocortical hyperfunction. Before any treatment or surgical interference is instituted, it must be determined whether there is an adrenal tumor present, and this is done by determining the 17-ketosteroid values, which are found to be increased in the presence of an adrenocortical tumor. Such tumors should be removed, and proper endocrine replacement therapy should be instituted. When no adrenal tumor can be found, treatment may consist of extirpation of a pituitary adenoma, if this type of tumor can be discovered, or one of several other forms of treatment, such as irradiation of the pituitary gland, irradiation of both the pituitary and the adrenal glands, the administration of estrogenic substance, and, in the experience of certain authors, the injection of androgenic hormone.

The author's personal experience with this syndrome consists of 7 cases, in 5 women and 2 men whom he treated mainly by short series of irradiation to the pituitary gland, repeated at 3 month intervals. He gives full case histories, and his results certainly seem to be as successful as those reported by other authors with other forms of treatment or with the same general plan of treatment. He obtained no satisfactory results with the use of estrogenic substance. He did not find that irradiation of the pituitary gland caused any noticeable ill effect on the normally functioning portion of the gland. His opinion and results are not in keeping with the opinion of Thompson and Eisenhardt (1943), who stated that roentgen treatment has failed in the majority of cases.

JOHN MARTIN, M.D.

Schleizinger, N. S., Alpers, B. J., and Weiss, B. P.: Suprasellar Meningiomas Associated with Scotomatous Field Defects. *Arch. Ophthalm.*, Chic., 1946, 35: 624.

Four cases of suprasellar meningioma are reported with particular reference to the eye findings and visual field changes. Emphasis is laid upon the occurrence of such visual loss with scotomas in the visual fields, associated with more or less severe headaches. The rapidity of onset of these symptoms may simulate, in the early stages, the clinical picture of retrobulbar neuritis and present some confusion in the diagnosis.

Completely uniform alterations in the visual fields do not occur as the result of suprasellar lesions. The early scotomatous field defects were demonstrated in the authors' 4 patients with suprasellar meningiomas. Scotomatous field defects serve as a clue to the existence of prechiasmal or chiasmal lesions, by combining with a peripheral encroachment on the visual field at some point so as to produce an expanding sector defect.



In the prechiasmal syndrome associated with suprasellar meningioma, the outstanding symptom was impairment of vision, rapidly progressive and affecting the 2 eyes successively rather than simultaneously, with slight pallor of the discs in the early stage, followed by subsequent optic atrophy. This clinical picture coupled with scotomatous changes (particularly expanding scotomatous defects) points toward a suprachiasmal lesion. The early recognition of this syndrome, particularly with reference to the meningiomas, is of importance in view of the relatively benign character of the tumor encountered.

HOWARD A. BROWN, M.D.

### SPINAL CORD AND ITS COVERINGS

Frugoni, P., and Pozzi, A.: Vertebral Echinococcosis (Echinococcosi vertebralis). *Polidinic, sez. chir.*, 1946, 53: 1.

The more significant of the 2 cases here reported was that of a 44 year old married woman who had been bedridden for 6 months when 16 years of age because of pains in the lumbar region. When 38 years old a thoracentesis was done, and later a thoracotomy, for echinococcosis of the upper lobe of the right lung. Three years later a spastic paraplegia occurred rather suddenly, which soon became flaccid in type. The laboratory disclosed an evident dissociation between the albumin (2.20%) and the cell count (0.1%) of the spinal fluid; lipiodol injection revealed a spinal block with the lower level at the seventh dorsal vertebra and the x-rays portrayed some rather indefinite areas of rarefaction in the body of the fifth dorsal vertebra.

During the laminectomy the laminae of the sixth and seventh dorsal vertebrae seemed more porous than normal. The completed laminectomy (D5 to D8) uncovered a huge cystic formation completely enclosing the dural sac and cross partitioned by fibrous matter into three subdivisions. These subdivisions contained a small amount of colorless fluid and about 70 tiny various sized cysts filled also with colorless fluid. The sac also contained some gelatinous material (probably deteriorated cyst walls) but no trace of chitinous material. The compressed cord was pushed anteriorly and to the left. The main sac was in communication, through the two foramina between the sixth and seventh and the seventh and eighth dorsal vertebrae, with what appeared to be an extension of the process into the right paravertebral region at this level.

Without opening of the dura, as much as possible of the sac and cysts were removed and that part of the sac which was adherent to the dura was formalized. The condition of the patient seemed to forbid following the extensions out through the intervertebral foramina into the chest region. At autopsy, about 3½ months later, the compressed condition of the cord had not changed.

In seeking an explanation for the odd findings in this case, the authors subscribe to the teachings of Grisel and Deve, whose views were expounded in the

*Revue de Chirurgie* (1929, 67: 464). They believe that in this case the primitive lesion developed in the body of the vertebra—as suggested by the roentgenogram of the fifth dorsal vertebral body—in the form of a multilocular invasive microcystic lesion which penetrated into the spinal canal through an aperture or apertures so insignificant as to escape detection. The resultant sac in the spinal canal, which was under pressure and enclosed in a firm osseous cavity, then sought a safety valve by boring out through the intervertebral foramina into the paravertebral region of the chest.

The authors emphasize the presence or absence of chitinous material in the intraspinal sac. In the latter contingency, occurring in the multilocular form with lack of a mother cyst, the laminectomy should be as extensive as possible and the pathological process widely removed. It is thought that in the presence of a paravertebral hydatid involvement, whether subpleural or retroperitoneal, or mediastinal or involving the paravertebral muscles back of the spinal column, the physician should always consider that this process might be secondary to a primitive echinococcal invasion of the vertebra and act accordingly.

The authors report a second case of intrarachidial echinococcosis without x-ray or other evidence of involvement of the bones of the spinal column and without extrarachidial extension, but with a history of a retroperitoneal echinococcus cyst, which was removed surgically. Three years later, symptoms of paraplegia appeared and progressed rapidly. At laminectomy an intrarachidial cyst was uncovered; it extended from the twelfth dorsal to the second lumbar spinal segments and communicated with the interior of the dural sac extrinsically, sitting astride, so to speak, the spinal cord itself.

This sac, filled especially in its intradural extension with daughter cysts and mildly suppurating, was removed as widely as possible. Following the operation the patient regained his ability to walk and his condition improved generally, but he died about a year later.

JOHN W. BRENNAN, M.D.

Silverman, S.: Vascular Tumors of the Spinal Cord Associated with Skin Hemangiomas. *Brit. J. Surg.*, 1946, 33: 397.

Although Sturge-Weber's disease has become rather well known, an analogous combination of vascular tumors of the spinal cord with corresponding segmental skin nevi has been less commonly observed. At the Midland Nerve Hospital in Birmingham, England, a case of this nature was studied and verified. The patient was a 47 year old female with an extensive congenital nevus involving the left side from the fifth cervical to the tenth thoracic dermatome. Eleven months before hospitalization, following a fall and laceration of the buttocks, the patient had developed a sudden paraparesis with an indefinite sensory level in the thoracic area. Acute exacerbations occurred on 2 occasions and finally resulted in a paraplegia with a definite sensory level.

Following a lipiodal myelogram a laminectomy was performed which revealed a mass of tangled blood vessels in the epidural space. After an uneventful convalescence deep roentgen therapy was given with improvement in the clinical picture.

Wyburn-Mason believed that there was no direct affective relationship between the two sites, but their coexistence was due to a developmental disorder of the whole neuromyodermatome. Usually they are in comparable segments of the spinal cord and integument. Oftentimes the spinal cord involvement is not recognized until hemorrhage occurs or the tumors increase in size. This frequently takes place in apoplectiform stages. The present case and those in the literature are of a simple hemangiomatic nature rather than hemoblastomatous.

JACK I. WOOLF, M.D.

Lindsay, J. S. B., and Falconer, M. A.: Painful Phantom Limb Treated by High Cervical Chordotomy. *Brit. J. Surg.*, 1946, 33: 301.

Pain occurring in association with phantom limbs has long been a difficult medical problem. However, in the past decade it has become well recognized that more than one factor or type of pain may be present. The psychological factors frequently present are not discussed in this article.

The authors believe that there are two main types of organic pain, the most common type being due to irritation of the peripheral nerve endings. This may involve either the peripheral sensory nerve fibrils or sympathetic nerve fibrils involved in or about the cicatricial formation. In the former, local resection or nerve block will relieve the pain, while in the latter a sympathetic block or sympathectomy will relieve the pain. When neither type of block will relieve the pain, it is thought that the pain impulses arise in the dorsal horn cells of the spinal cord, and hence section of the spinothalamic pathway or ablation of the cortical sensory area will alleviate the pain. Chordotomy should be preferable to cortical ablation since it removes only the pain and does not interfere with cortical sensory perception, and therefore it permits the use of the stump for prosthetic devices.

Sectioning of the pain pathways to the lower extremity is easily performed by a high thoracic anterolateral chordotomy. However, in the past it has been difficult to perform a similar section for pain in the upper extremity. The authors incorrectly state that mesencephalic tractotomy (Walker) and medullary tractotomy (Schwartz and O'Leary) have failed to produce a sufficiently high level of analgesia. This is derived from their first report, for later publications have shown that high levels of analgesia have been obtained. In a discussion of Walker's paper (*Arch. Neur. Psychiat.*, 1942) both Grant and Peet give some of their results with a high cervical chordotomy at C<sub>2</sub>. Although a satisfactorily high level of analgesia was obtained in some cases, the results were not uniformly good in larger series. Anterolateral chordotomy in the high cervical region midway between the nerve roots of C<sub>1</sub> and C<sub>2</sub> was

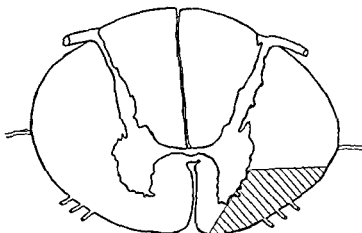


Fig. 1. Diagrammatic cross section of cervical cord to show extent of chordotomy.

performed by the authors on 2 patients. Both patients had been studied preliminarily by paravertebral and local nerve blocks without relief of pain. Complete relief of the pain was obtained without affecting the awareness of the phantom limb.

A note of caution is suggested in the report of the second case in which an ipsilateral hemiplegia was noted immediately after the sectioning. Fortunately, this cleared up in about an hour; however, the possibility of more permanent damage must be recognized.

The accompanying diagram shows the probable extent of the chordotomy.

JACK I. WOOLF, M.D.

### PERIPHERAL NERVES

Bonola, A.: Brachial Plexus Paralysis from Gunshot Wounds (Le paralisi del plesso brachiale per ferite d'arma da fuoco). *Chir. org. movim.*, 1943, 29: 12.

Twenty-five cases of brachial plexus injury from wounding by firearms came under observation at the Rizzoli Orthopedic Institute in Bologna. Of these, 15 underwent exploratory operation. Seven of the operative cases are reported in detail, and diagrams, sketches, and actual photographs of the conditions encountered are given in the original article.

The incision used in every case was the one which was developed at this institute. It starts well up on the neck, extends vertically along the outer border of the sternocleidomastoid muscle, crosses the clavicle, and passes down toward the axilla along the deltoideopectoral sulcus. To this incision may or may not be added a transverse incision along the upper border of the clavicle. The clavicle was usually cut through toward its outer end and retracted in both directions with the aid of a sand bag under the scapula. Any injury to the blood vessels, of course, was given first attention (aneurysm, arteriovenous aneurysm) and then an attempt was made to assess and repair any injury of the nerves and trunks of the plexus itself. In some instances the nerves were not completely separated, but were compressed by th

conditions by a plethysmograph, is greatly influenced by emotional stimuli, drafts, and pain mediated through the peripheral sympathetic nerves. The reflex effects of heat and cold are ineffective in an extremity which has been subjected to a sympathectomy. After a sympathectomy an arteriosclerotic limb maintains a circulation comparable to that which could be obtained only in a warm, semitropical climate, the benefits of which are well known in the treatment of peripheral arteriosclerosis.

Another factor is the high vasomotor tonus in the lower extremity of man which helps to maintain the normal blood pressure. This tonus is least in a horizontal position, greater in a sitting position, and greatest in the erect posture. How such a postural vasoconstriction affects a diseased vascular bed is obvious. This factor is eliminated by sympathectomy so that the vasomotor tonus is not any higher when the patient is erect than when he is horizontal. Therapeutically this is analogous to rest in bed. Although intrinsic muscle tone is regained after a period, it has been shown previously that the venocapillary stretch produced by intermittent venous hyperemia is far more effective in the sympathectomized limb than in the limb with an intact sympathetic supply.

The striking relief of pain which is obtained in limbs following procaine block and sympathectomy,

whether due to thromboangiitis, arteriosclerosis, or embolic occlusion, is not completely understood. An ingenious theory postulated by Doupe states that cross stimulation occurs between efferent sympathetic nerves and the demyelinated, poorly insulated sensory axons which results in pain or even efferent vasodilatation. Another cause is suggested by the reflex vasoconstriction which occurs after pain. This operates in the case of ischemic neuritis, thrombosed arterial segments, or periarterial and lymphangitic inflammatory reactions, and is abolished by sympathectomy.

The effects of lumbar sympathectomy on the lower extremity are tabulated:

1. The limb warms faster and cools more slowly on direct exposure, and reflex effects of heat and cold are ineffective.
2. The high vasoconstrictor tonus in the sitting and standing position is abolished.
3. Vascular exercises such as intermittent venous hyperemia are more effective.
4. Cross stimulation between the sympathetic and demyelinated sensory fibers is prevented.

The excellent results in this small series are stated to be "due to the release of normal vasomotor tonus, which in turn insures an even blood flow uninfluenced by anything but the metabolic need of the tissues."

C. FREDERICK KITTLE, M.D.

# SURGERY OF THE THORAX

## CHEST WALL AND BREAST

Garven, H. S. D.: *Demodex Folliculorum in the Human Nipple. Lancet, Lond., 1946, 2: 44.*

Ten of 13 cases observed by the author showed the presence of a parasite corresponding in size and structural details to the *Demodex folliculorum*. The parasite may be found lying in the sebaceous material in the mouths of the sebaceous glands, with the head directed toward the living cells of the glands. In many cases, it is also found lying deep in the gland among the living cells with its head close to or almost touching the basement membrane of the gland. In this situation it may cause some reaction in the tissues surrounding the gland. Round cell infiltration of these tissues is common.

The significance of the prevalence of the parasite in the sebaceous glands of the nipple in this series cannot be assessed without further investigation over wider areas. It is not suggested that the presence of the parasite in the sebaceous glands of the nipple is of real importance in the pathogenesis of carcinomatous changes in the epithelium of the nipple as in Paget's disease. Its relevance as a factor in the incidence of sore nipples has been suggested.

EMIL C. ROBITSHEK, M.D.

## TRACHEA, LUNGS, AND PLEURA

Langer, L., and Salvestrini, H.: *Surgical Treatment of Bronchiectasis (Tratamiento quirurgico de las bronquiectasias). Rev. med. Chile, 1946, 74: 328.*

This article constitutes a rather complete presentation of the problem of bronchiectasis, including the prognosis of the disease without surgical treatment, the clinical picture, the method of diagnosis, relative distribution of the involvement, and surgical treatment.

The preoperative preparation, stressing drainage through the bronchus and antibiotic therapy, was described. The details of the operative procedure are given at some length, and the postoperative care is also presented in detail.

A series of 104 patients were operated upon during the last 2 years, undergoing a total of 110 resections without mortality. These patients were seen on the service of Overholt in Boston, Massachusetts.

HIRAM T. LANGSTON, M.D.

Dickson, J. A., Clagett, O. T., and McDonald, J. R.: *Cystic Disease of the Lungs and Its Relationship to Bronchiectatic Cavities. J. Thorac. Surg., 1946, 15: 196.*

Twenty-two surgically treated patients with cystic disease of the lungs were selected for study. In 12 cases the cysts were developmental or congenital, in 6 cases they were acquired (including "cystic" bronchiectasis), and in 4 cases they were

indeterminate. Most of the cysts had a bronchial communication. All but 3 cysts were infected. In no case was there any evidence that bronchogenic carcinoma had its origin within the wall of one of these benign cysts.

Hemoptysis was present in 16 of the 22 cases. In cases of cystic disease of the lungs a diagnosis of pulmonary tuberculosis is often made. An accurate diagnosis of cystic disease of the lungs is largely dependent on adequate roentgenographic examination of the thorax. It is believed that bronchoscopy is of definite value, especially for the patient who is to be treated surgically, to rule out any possibility of other bronchial lesions. Occasionally, an accurate diagnosis can be arrived at only by exploratory thoracotomy. In the differential diagnosis, consideration must be given to almost all intrathoracic neoplasms, pulmonary abscesses, localized empyemas, tuberculous cavities, hydatid cysts, and diaphragmatic hernias.

The ideal treatment for cystic disease of the lungs is complete operative removal of the cystic portion of the lung with conservation of as much normal functioning lung as possible. Local excision is only occasionally feasible, as in a case in which the cyst may be attached by a narrow pedicle or loosely attached to the parenchyma of the lung. Drainage of the cyst and other supplementary operations, such as collapse procedures, usually are not satisfactory. Age appears to be no contraindication to surgical treatment.

## HEART AND PERICARDIUM

Poppe, J. K., and De Oliveira, H. R.: *The Treatment of Syphilitic Aneurysms by Cellophane Wrapping. J. Thorac. Surg., 1946, 15: 186.*

The surgical treatment of aneurysms is still an open field despite the various methods mentioned in the medical literature, and even despite the modern surgical techniques available at the present time. According to Pearce, the surgical attempt at producing progressive obliteration of the lumen of the great vessels appeared in the nineteenth century.

A number of methods and devices have been advocated for the production of occlusion of large blood vessels, with unsatisfactory results in many instances. In addition to the ineffectual results and fatal complications accompanying the use of many of these methods, almost all of them, with one or two exceptions, are too traumatic for application to a dilated, thin-walled syphilitic aneurysm which is about to rupture spontaneously.

Pearce, in 1940, showed that the chronic progressive irritation, fibrosis, and foreign body reaction caused by the insertion of ordinary 300 P.T. cellophane in close proximity to the vessel, provide a method of thickening the wall and occluding the

lumen of a blood vessel without the objections mentioned.

The first recognition of the irritating properties of cellophane resulted from the studies of Page, who wrapped the kidneys of dogs in cellophane in 1939 to produce hypertension. A marked tissue reaction was said to have occurred within 3 to 5 days following the application of the cellophane. Within 2 weeks a dense fibroblastic and collagenous deposit developed over the surface of the kidney and formed a constricting hull of from 3 to 5 millimeters in thickness. This hull continued to thicken for an undetermined period of time despite the disappearance of the cellophane.

In direct contradistinction to the work of Page, Pearce, and Harrison and associates, are the results of another group who considered cellophane as a physiologically inert substance suitable for application and insertion into areas of the body in which a foreign body reaction and adhesions would be very undesirable. Donati was the first to demonstrate this inert property of cellophane, in 1946.

Later, McKeever used cellophane in the treatment of arthritis. He used type 300 P U T. 71 and concluded, as did Donati, that no reaction is caused by cellophane for at least two months after operation.

These various physiological reactions of cellophane exhibited diametrically opposite properties. On one hand, cellophane represented an inert substance which produced practically no foreign body reaction when left in the tissue, and, on the other hand, induced a violent fibrous tissue reaction resulting in fibrosis and contraction. This led to the conclusion that different varieties of cellophane produced entirely different physiological reactions, depending upon the chemical structure of the material. Before any satisfactory clinical application could be made of the properties of cellophane to produce a constrictive fibrosis, a distinction was needed between the physiologically inactive and reactive types of cellophane. For that reason, a series of animal experiments was conducted on dogs, in which five different basic types of cellophane were used. A very marked fibrous tissue reaction surrounding the section of the aorta in close proximity to the polythene variety of cellophane was noted in both animals in which it was used. The reaction was still acute as indicated by the cellular proliferation in the first animal in which the tissue was examined 2 weeks postoperatively. A very dense fibrous proliferation was present in the tissue surrounding the section of aorta covered with the polythene variety of cellophane in another animal sacrificed 2½ months postoperatively. In this case, not only had the wall of the aorta increased to six times its normal thickness, but the lumen of the vessel had been reduced to about one-third of its normal diameter.

A report of the successful clinical application of the polythene variety of cellophane to a fusiform aneurysm of the thoracic aorta is described in detail. The most satisfactory way to avoid the contact of the surrounding structures with this extremely re-

active polythene film seems to be to cover it with a layer of less reactive polythene, such as 300 P.U.T. 71, 300 P.T. 62, or one of the moisture-resistant varieties. Further animal experiments are being carried out at the present time on refinements in technique, this representing a preliminary report.

Polythene film was also used recently for the ligation of a recanalized ductus arteriosus in a 14-year-old colored girl with subacute bacterial endocarditis in whom the patent ductus had been ligated 4 years previously with cotton umbilical tape. A certain amount of caution is necessary, however, to keep the cellophane away from the recurrent laryngeal nerve.

The use of polythene cellophane seems to offer a successful method of gradual fibrosis and obliteration of aneurysms and large vessels. Experimental studies reported here have shown that in order to obtain the desired result, it is necessary to use a particular type of cellophane, since some varieties produce no fibrosis. Polythene cellophane has been found useful not only in the treatment of aortic aneurysms, but also in the obliteration of a patent ductus arteriosus. JOHN E. KIRKPATRICK, M.D.

## ESOPHAGUS AND MEDIASTINUM

Resano, J. H.: Activities of the Department of Esophageal Diseases for the Year 1945 (Actividades del departamento de esófago durante el año 1945). *Prensa méd. argent.*, 1946, 33: 1072.

In the Argentine Republic an estimated 1,000 persons die annually from carcinoma of the esophagus. A special service for the management of esophageal lesions has been in function since the end of 1939. Five hundred and nineteen patients have been seen in this period; they presented cancer as the predominant lesion, followed by megaesophagus in the proportion of 10 or 15 cases to 1. During 1945, 21 cases with symptoms of esophageal disease were seen in which no lesion was readily demonstrable.

The total number of cases of esophageal disease seen in 1945 was 159. Of these, 111 were carcinomas, and the 21 cases already referred to were as follows: 7—megaesophagus, 4—strictures due to caustics, 3—diverticula, 2—cardiospasm, 2—simple esophageal spasm, 2—foreign body, 1—post-typhoidal esophagotracheal fistula, 1—congenital stricture, 1—dysphagia due to situs inversus, and 1—paralytic dysphagia.

The relative distribution of carcinomas in the esophagus showed 19 to be in the upper third, 36 in the middle third, and 56 in the lower third. One case involved the entire organ.

The management of these 111 cases may be summarized as follows: 5 had not been operated on at the time of the report; 33 were considered inoperable principally because of great debility, advanced age (70 years is considered an average upper limit), or uncontrollable associated diseases; 11 patients refused operation; 30 were submitted to exploratory operations; 32 underwent radical resection; 19 underwent a Torek procedure, with 11 deaths; 11

underwent resection with an intra-aortic esophagogastric anastomosis (6 deaths); and 2 underwent resection with supra-aortic esophagogastric anastomosis (2 deaths).

Resection with anastomosis is the constant aim, but is not always possible. A case of low esophagogastric lesion is reported in which the extensive neoplasm required a total gastric resection. The performance of an esophagojejunostomy was prevented by an unusually short mesentery so that a cervical esophageal stoma was made after complete extirpation of the thoracic esophagus. Feeding is maintained by jejunostomy.

HIRAM T. LANGSTON, M.D.

Resano, J. H. Notes on the Diagnosis and Treatment of Carcinoma of the Esophagus (Comentarios sobre diagnóstico y terapéutica del carcinoma del esófago). *Prensa méd. argent.*, 1946, 33: 912.

Despite the usual concept that tumors occurring in narrow portions of the digestive tract are diagnosable while still of small size, carcinoma of the esophagus comes to diagnosis relatively late. This is explained in the author's experience by:

1. The natural latent period of any disease. He estimates the length of life after the development of the neoplasm as of 2 years, for the maximum.

2. Delay on the part of the patient in seeking competent medical advice. Since the symptoms may be variable from day to day, he continues to hope that they will disappear.

3. Delay on the part of the physician in recognizing the true nature of the process while striving for relief with various antispasmodics.

In the author's experience some 20 per cent of the patients have received antilutetic therapy when first seen, notwithstanding the rarity of esophageal syphilitic involvement (not 1 instance in 6,000 autopsies). One case of esophageal syphilis is briefly presented; this occurred in the author's series of more than 450 cases of esophageal disease. The stenotic areas were multiple.

Further causes for delay in treatment arise from confusion produced by the good general condition of the patient early in his symptomatic course, and the poor quality, or the improper interpretation, of the x-ray studies. Several case reports are quoted and illustrated. The accuracy of the x-ray diagnosis is attested by the statement that on the service of Finochietto, only 2 cases of carcinoma of the esophagus in a series of 350 gave normal x-ray findings.

The author calls attention to a statement attributed to Seiffert (reference omitted), in which he claims to have seen 2 cases of spontaneous cure of esophageal carcinoma. The author cites 1 personal observation in which esophagoscopic and x-ray examination revealed marked regression. This patient, however, died at the end of 16 months of an aortic perforation by the carcinoma.

The treatment is discussed at some length and illustrated. Roentgen therapy is not considered curative. Esophageal resection, with esophagogastric anastomosis, when possible, is practiced, a cervical

esophageal stoma being produced only when necessary. Eighteen successful results have been obtained: 3 with the Torek procedure, 11 with esophagogastric anastomosis below the aortic arch, and 4 with anastomosis above the arch. Two of the 3 patients who underwent the Torek procedures died at 7 and 8 months, respectively, of metastases. Five of the patients subjected to infra-aortic esophagogastric anastomosis died in from 4 to 18 months. All of the patients in whom supra-aortic anastomoses were effected have survived. The longest survival period of any patient is 26 months.

HIRAM T. LANGSTON, M.D.

Castoldi, P.: Malignant Granuloma of the Mediastinum of a Neoplastic Developmental Form with Infiltration of the Pulmonary Parenchyma (Granuloma maligno mediastinico a sviluppo neoplastiforme con infiltrazione del parenchima polmonare). *Tumori*, Milano, 1942, 28: 358.

A 16 year old girl succumbed to a huge tumor in the left side of the chest. At autopsy, 24 hours later, the mass, which was of the size of an adult head, was removed en bloc, together with the mediastinum and left lung. On histological examination the tumor proved to be typical of granuloma malignum. However, the most interesting finding was that of the left lung. This organ was collapsed, had spread over the upper, posterior surface of the granulomatous mass, and had apparently grown to it in one area.

Histological sections of the lung tissue in this area revealed, in places where the process seemed most recent, that the pulmonary alveoli were plugged with cellular elements of a marked polymorphism, in which many of the cells bore a marked resemblance to the Sternberg cells of granuloma malignum. The author characterized the whole process as one of desquamative pulmonitis. This process differed, however, from the ordinary desquamative alveolitis by the cellular polymorphism. In some of the alveoli a fine fibrillar rete was present. The alveolar septa were still present and evidenced a hyperplasia and intra-alveolar desquamation of the reticular cells.

There was no sign of a fibrinoleucocytic (exudative-inflammatory) reaction in the sense of Deak, and the author interpreted the condition as a true lymphogranulomatous pulmonitis as described by Braitenberg.

JOHN W. BRENNAN, M.D.

## MISCELLANEOUS

Brock, R. C.: A Musculoplastic Incision for Posterior Thoracoplasty. *J. Thorac. Surg.*, 1946, 15: 182.

The usual incision for posterior paravertebral thoracoplasty is carried straight down through the skin and underlying muscles to the ribs, to make a J-shaped flap which is reflected forward. This method of making the incision has many disadvantages.

For the past year the author has been using a simple musculoplastic modification of this incision which seems to avoid most of its disadvantages. It is a simple and logical step and has proved very satisfactory in practice.

The usual J-shaped incision is made down to, but not through, the muscles of the back. The medial flap is now undercut as far as the midline for the whole length of the vertical limb; the undercutting is continued into the first 3 or 4 inches of that part of the incision which curves forward, typically to just beyond the anterior border of the trapezius muscle. This undercutting is carried downward and medially for some 2 inches to expose the lowest part of the trapezius to within 2 inches of its lowest origin, where it is little more than  $1\frac{1}{4}$  inches wide. The most anterior part of the incision need not be undercut, but its lower edge should be retracted before the latissimus dorsi is divided. The incision in the latissimus dorsi is carried back to the lowest exposed portion of the trapezius, and this muscle is then cut through transversely to the midline. A finger is next inserted beneath the trapezius immediately next to the origin from the spinous processes, care being taken to separate the muscle from the aponeurosis covering the erector spinae mass, to which it may be moderately adherent. With scissors or a knife, the trapezius is cut as near as possible to the spinous processes and the interspinous ligaments. With the finger separating the muscle in front of it, the division is carried right up to the top of the wound. The rhomboid muscles are, of course, raised with the trapezius when they are reached, the serratus posterior superior may also be included, or left on the ribs, if desired. As the aponeurosis is being cut, a little care will enable one to see and secure the medial divisions of the posterior branches of the intercostal vessels to further minimize the blood loss. The whole muscle flap is now displaced forward in the usual way. As it is raised, the lateral division of the posterior branches of the intercostal vessels

is displayed and the muscles can be secured and divided without blood loss. If the serratus postero-superior muscle has been lifted with the flap, it can now be separated from its insertion into the ribs. At the end of the operation the reflected muscle layer is sewed back to its original attachment to the spinous process and the supraspinous and interspinous ligaments.

At the second stage the maneuver is repeated; the separation is made with ease and there is very little "gumming" together of the layers as is seen when the muscles have been cut through. The aponeurosis can be cut from the midline as easily as at the first stage and can be resutured into position just as easily and securely. The separation of the muscle flap is almost entirely bloodless at the second stage.

The advantages claimed for this musculoplastic incision are as follows:

1. A long, unsurgical division of muscle tissue is avoided, with consequent diminution of the blood loss, interruption of the nerve supply, and subsequent impairment of the function from atrophy and fibrosis.
2. The posterior scapular artery is completely out of danger when the highest part of the incision is made.
3. The exposure is definitely improved, the access to the posterior ends of the ribs is simplified, and it is not necessary to carry the incision quite so high as when the muscles are cut through and not reflected.
4. The two suture lines are not superimposed, and if the skin sutures should give way, the extrafascial space is protected by the muscle layer.
5. There is virtually no bleeding from the muscle layer at the second stage.

JOHN E. KIRKPATRICK, M.D.

# SURGERY OF THE ABDOMEN

## ABDOMINAL WALL AND PERITONEUM

**Salsano, D.: Fibroma of the Left Rectus Abdominis Muscle in the Male (Fibroma del muscolo retto addominale di sinistra in uomo).** *Ann. ital. chir.*, 1943, 22: 572.

The primitive fibroma of the abdominal wall, especially in the male, is extremely rare. Indeed some authors deny its entity and attribute tumors described as such in males to the fibromatous products of chronic inflammations or to the reparative processes following rupture of a muscle. The author reports a case of tumor situated in the left upper abdominal wall in which there could be no doubt, either from the clinical history or from the histological findings, of its being a fibroma.

The robust soldier whose case is reported had accidentally noted a small tumefaction of the left superior quadrant of the abdominal wall about a month previously. At operation a walnut sized mass was exposed under the anterior sheath of the left abdominis rectus muscle about 2 finger-breadths from the midline and the same distance above the level of the umbilicus. The growth was situated at the level of one of the tendinous inscriptions of the abdominis rectus but had developed within the entire thickness of the muscle and showed no evidence of capsule formation.

The new growth was excised, the incisions reaching well into the healthy muscle, and the histological examination reported the findings of a simple fibroma. There was an intermixture of some striped muscle fibers showing the simple degenerative picture of pressure from the surrounding fibrous tissues. At the edge of the tumor mass its fibers seemed to be continuous with the fibers of the intermuscular connective tissues.

Seven months later the patient was perfectly well and there was no evidence of local recurrence or of metastasis.

JOHN W. BRENNAN, M.D.

## GASTROINTESTINAL TRACT

**Duran-Jorda, F.: A Microincineration Study of the Flat Epithelial Layer Covering the Alimentary Tract.** *Brit. J. Surg.*, 1946, 33: 346.

The author has demonstrated, by using the microincineration technique, the organic nature of the flat epithelial layer, previously described by him, which covers the gastric and intestinal mucosae and the gall bladder mucosa.

The gastric and intestinal mucosae are covered by a layer of flat epithelial cells which contains a variable number of diapedic cells and a network of capillaries. Between the layer and the pits of the glands there is a kind of albuminous fluid which in some stomachs becomes clotted and produces a cast of the whole elements contained in the flat epithelial

layer. This layer is very friable, especially because it is bathed in the juices contained in the gastric and intestinal mucosae. The link between the layer and these mucous membranes is very fragile, and it was for this reason that the author was compelled to develop a new method of fixation to study the layer. This method will be referred to herein as formalin vapor fixation, and was carried out by submitting the tissues to formalin vapor in a closed atmosphere, at room temperature, for 2 or 3 days.

As a consequence of uncertain methods of staining both the cytoplasmic cellular mucus and the supposed mucus covering the mucous membrane, the author decided to resort to a more drastic method of investigation. After a careful consideration of the problem he concluded that the most satisfactory technique to reveal the organic nature of the flat epithelial layer described was to submit the tissues to microincineration for then a subsequent study of the remaining ashes could be made.

Mucin cannot leave any mineral ashes after incineration. This is a fact well known by research workers who have used the microincineration method of studying the ashes contained in the tissues. As the mucin does not leave any ashes after its incineration, the spaces occupied in the cytoplasm of the cells secreting mucin or pseudomucin are empty when the tissue is studied after incineration. When describing the cells in the mucous membrane of the stomach, small intestine, and colon, microincinerators are quite definite that the empty spaces seen in the cytoplasm of some mucous membrane cells are the places previously occupied by the mucus, which does not leave any ashes. Then it can be concluded that if the layer covering the gastric and intestinal mucosae is basically formed by an accumulation of mucinous material, it will disappear after incineration and be substituted by an empty space.

To carry out these studies alternate slides of serial sections of the mucosae to be investigated were subjected to microincineration. From these sections, the first was stained with hemalum and eosin, the second was submitted to microincineration, and the third was treated with a mucin stain. The specimens selected had previously been subjected to formalin vapor fixation and embedded in paraffin blocks. Occasionally, one of the stained slides was incinerated after some photomicrographs were made of it, and after microincineration more photographs were taken of the same fields to compare the two sets. The specimens of different mucosae studied came from surgical specimens, as the protective layer is destroyed immediately after death, and the author supplemented the investigations by making a further study of some specimens from the mammal alimentary tract. The animals used were rabbits.



In the stomach there is a layer which comes from the upper layer of the tunica muscosa of the esophagus, covers all of the stomach, and passes to the intestine. This layer has been seen to cover not only the surface of the stomach, but also some of the pits of the glands. Sometimes, in the same section, it can be observed how some portions are formed only by single cells, while others are formed by multiple cells. This layer is rich in a network of capillaries. After microincineration, the layer leaves thick ashes. The layer covering the stomach is thicker than the layer in the small intestine; the explanation for this could be the presence of hydrochloric acid in the gastric mucosa. The layer can be peeled off from the stomach if the mucous membrane has been subjected to formalin vapor fixation. It is very transparent and can be sectioned. The incineration of the layer itself leaves ashes, which demonstrates that the layer is not merely dried, inspissated mucus.

In the small intestine there can also be found a covering layer, this is confirmed by incineration. The layer appears to be very thin and contains small capillaries. The thinness of the layer can probably be attributed to the fact that in the intestine the pH of the media is in the alkaline range.

In the appendix the covering layer shows diverse cellular contents and in some microscopical fields it is monocellular. In other fields it contains a very large quantity of diapedesic cells. The existence of capillaries can also be demonstrated in this layer covering the appendix. After microincineration the ashes are very thick, which is in accordance with the number of cells contained in the covering layer. The explanation for these thick ashes is quite logical when one considers that the nuclear chromatin of the diapedesic cells is pyknotic and concentrated.

In this organ the layer has the same appearance as the layer found in the stomach. It is very thick and vascularized, probably because a great deal of bacterial fermentation takes place in the colon as a result of the anabolism of the hydrocarbonates present in the food remnants, and consequently the mucosa required a thick layer as a protection against the organic acids formed by bacterial and enzymatic fermentation. The ashes of this layer are also very thick, similar to those of the layer in the gastric mucosa.

By observing the layer from the colon mucosa to the rectum and the anal stratified squamous epithelium, it can be seen how the layer passes from one organ to another and later becomes included in the stratum lucidum of the anal skin. In some of the specimens it is evident that the covering layer still contains capillaries, which are continued in the stratum lucidum of the anal skin, and this raises the question as to whether there are capillaries between the layers of the stratum lucidum and the stratum corneum in the skin.

The layer in the gall bladder appears to be similar to that found in the small intestine, and contains a few cells and small capillaries. After incineration it leaves well marked ashes.

After submitting different specimens of mucous membrane from the alimentary tract to the process of microincineration the author is now in a position to dismiss definitely the supposition that the existence of this layer is unreal, or is the consequence of the clotting of mucus present in the gastric and intestinal tract as a result of the formalin vapor fixation for the preparation of these organs. There can, therefore, be no doubt that the covering layer, which is formed by flat epithelial cells, diapedesic cells, and capillaries, is a true organic formation, which should be considered in the future study and description of the histology and pathology of the mucous membrane of the stomach, intestines, and gall bladder.

CHARLES BARON, M.D.

Ladd, W. E., Ware, P. F., and Pickett, L. K.: Hypertrophic Pyloric Stenosis. *J. Am. M. Ass.*, 1946, 131: 647.

The senior author and his associates are noted for many valuable contributions to the management of congenital hypertrophic pyloric stenosis. This report is a general review of the subject and deals particularly with 380 patients operated on between 1930 and 1945.

Eighty-five per cent of the patients with hypertrophic pyloric stenosis are males and frequently they are the first born of a family. The pathogenesis probably results from a combination of pylorospasm and work hypertrophy due to a congenital pyloric tumor together with edema of the mucous membrane from mechanical irritation by curds. The essential pathological finding is hypertrophy and hyperplasia of the circular smooth muscle layer of the pylorus.

The onset of symptoms occurs between the second and fifth weeks of life. Dehydration is usually pronounced when the patient is first seen. Vomiting begins as infrequent regurgitation but progresses to an explosive nature and soon occurs after almost every meal. However, the child remains hungry and will feed eagerly even immediately after vomiting. The vomitus never contains bile. The child soon loses weight, the stools become scanty, and alkalosis develops.

The most important physical finding is a palpable olive sized mass in the right upper quadrant of the abdomen. This can be identified best immediately after the infant has vomited. Peristaltic waves may be observed during feeding and, characteristically, appear only in the epigastrium.

Differential diagnosis is seldom difficult. One must consider pylorospasm, infectious vomiting, improper feeding, intracranial injury, achalasia, and extrinsic and intrinsic intestinal obstruction.

The most important aspect of preoperative care is proper fluid therapy. It is essential to restore the baby to as nearly a normal nutritional state as possible by correction of dehydration, ketosis, and chloride deficiency. Operation is never an emergency procedure; 2 or 3 days of preparation should be the minimum. In general, the infant should receive

from  $2\frac{1}{2}$  to  $\frac{3}{4}$  oz. of fluid per pound of weight daily. In poor risk debilitated patients plasma and whole blood transfusions will be necessary to restore the normal serum protein level and to improve the patient's general condition. These may be given in amounts corresponding to 10 c.c. per pound of body weight. Vitamin C may be given in the clysis fluid. Full formula feedings are maintained during the preoperative period regardless of the vomiting, for small amounts of feeding will be absorbed.

In the preparation for operation conservation of body heat is of great importance. A small urethral catheter serves to keep the stomach aspirated during operation. Ether given by open drop is the anesthetic of choice. The Robertson gridiron incision has been the preferred surgical approach to the lesion in this group of patients.

The operative procedure of pyloromyotomy is described in detail, and a satisfactory postoperative feeding regimen is given.

Complications include duodenal perforation, otitis media and pneumonia, wound infection, and evisceration.

In this series 380 patients with hypertrophic pyloric stenosis were operated on with 4 deaths. In the past  $3\frac{1}{2}$  years there have been no deaths among 225 consecutive cases. EDWARD W. GIBBS, M.D.

Barber, M., and Franklin, R. H.: Bacteriology of Peptic Ulcer and Gastric Carcinoma. *Brit. M. J.*, 1946, 1: 951.

Unexplained sepsis, which occasionally occurs after apparently uncomplicated cases of partial gastrectomy, may lead to the development of a subdiaphragmatic abscess or, more rarely, to general peritonitis and death. The present investigation was undertaken to determine whether any pathogenic bacteria were present in the stomach and duodenum at the time of operation.

The normal bacterial flora of the alimentary tract has been the subject of much work and even more discussion. Another aspect which has caused considerable controversy is the importance of bacteria in the alimentary tract. The possible activities of bacteria in the intestines under different conditions are legion and remain a matter for speculation.

In contrast to the prolific flora of the large intestine, the stomach and first part of the duodenum in the healthy adult are usually sterile, except just after a meal. Spallanzani (1783) was the first to draw attention to the antiseptic properties of gastric juice. Garrod (1939) showed that susceptibility to the bactericidal action of hydrochloric acid of any pathogenic bacteria entering the body via the alimentary tract varied considerably, and that gastric juice was more bactericidal than hydrochloric acid of equivalent strength. In gastric disease it has repeatedly been shown that bacteria may actually multiply in the stomach.

More recent work on the bacteriology of the stomach and duodenum has been carried out mainly to answer two questions: (1) whether infection plays

a part in the causation of peptic ulcers; and (2) whether postoperative sepsis is related to the bacteria which are present in the stomach at the time of operation.

In spite of a voluminous literature the number of studies in which organisms were taken direct from the stomach and duodenum at operation and the isolated bacteria were fully identified is small.

In the present study, swabs were taken from the mucosa of the stomach and duodenum at operation in a series of 50 patients undergoing partial gastrectomy. Each swab was inoculated on to two blood-agar plates, one of which was then cultivated aerobically and the other anaerobically. Bacteria appearing on these plates were isolated in pure culture and, when possible, identified. In most cases test meals were given before operation and a portion of ulcer was examined histologically. Bacteria were isolated from 16 of 40 cases of benign ulcer and 9 of 10 cases of carcinoma. Pyogenic cocci (*Streptococcus pneumoniae*, *Staphylococcus aureus*, and Lancefield A hemolytic streptococci) were isolated from 7 cases.

*Monilia albicans*, nonhemolytic streptococci, and coliform bacilli were isolated from many patients who had a normal or high gastric acidity. All other bacteria were isolated only from cases in which the test meal showed a condition approaching achlorhydria. In this series of 50 cases septic postoperative complications were no higher among the 25 cases with positive cultures than among the other 25. The isolation, however, of such organisms as *Streptococcus pneumoniae*, *Staphylococcus aureus*, and Lancefield A hemolytic streptococci makes it clear that bacteria in the stomach at the time of operation are a potential source of infection, and preoperative medication might be advisable at least in the cases with low gastric acidity.

JOHN E. KIRKPATRICK, M.D.

Debeyre and Jouve: Ulcer of the Greater Curvature of the Stomach Penetrating into the Spleen with Secondary Perforation into the Peritoneal Cavity (Ulçère de la grande courbure de l'estomac tétrébrant dans la rate secondairement perforé en péritoine libre). *Presse méd.*, 1946, 51: 395.

The authors report a case of ulcer of the greater curvature of the stomach with penetration into the spleen and secondary perforation into the free peritoneal cavity. The patient was a 69 year old man with symptoms of an acute perforation of 2 days' duration. He was treated by immediate operation, with resection of the ulcer without splenectomy, and died 48 hours after operation.

A review of the literature failed to disclose an identical case, but the authors collected 19 reports of perforated ulcer of the greater curvature of the stomach. In 8 of these the lesion had penetrated into the spleen, and in 5 there was penetration into adjacent viscera. Five patients had a perforation into the free peritoneal cavity, and 2 had perforation into the lesser peritoneal cavity.

In general, penetrating and perforating ulcers in the greater curvature have a less favorable prognosis than similar lesions located elsewhere in the stomach. The reported mortality rate is 20 per cent.

EDWARD W. GIBBS, M.D.

**Gordon-Taylor, G.: The Present Position of Surgery in the Treatment of Bleeding Peptic Ulcer.** *Brit. J. Surg.*, 1946, 33: 336.

The results of therapy during recent years in more than 1,700 cases of hemorrhaging peptic ulcer treated at the St. George's and the Westminster Hospitals, London, St. Mary's Hospital, Balham, certain hospitals of the London County Council and the Westminster County Council, and of the larger, unspecified, Royal Naval Hospitals in the United Kingdom are collated and discussed. Cases of bleeding peptic ulcer treated nonoperatively are considered particularly in a conjecture as to the percentage of patients that might have been saved had surgery been performed.

Gordon-Taylor notes that the mortality of these cases has decreased in the past 10 years because of more adequate medical management, especially the early institution of "drip transfusion." The mortality is now from 10 to 11 per cent as compared with 24 per cent for the period from 1926 to 1933 despite the fact that many patients have been aged and infirm. The author believes that every case of hematemesis or melena should be transfused early with whole blood at 40 drops per minute. Early operation (before Finster's critical third day) gives a definitely lower mortality rate, hence close consultation between physician and surgeon is required. When surgery is performed it should be directed only at control of the bleeding; it must be quick and gentle, and abdominal exploration is discouraged. In cases in which it appears obvious from the terrific bleeding that a larger vessel has been eroded immediate intervention is indicated. Urgent operation is indicated in those cases of hemorrhage in which there is also evidence of obstruction because in these bleeding is most apt to persist or to recur promptly. Urgent surgery is indicated in persons past the age of 50, particularly if the radial artery is thickened and tortuous, and is similarly indicated in these older patients if the pain persists after hemorrhage. Recurrent hemorrhage in a patient under what should be adequate medical control is deemed an indication for surgical intervention. The foregoing views are supported by Avery Jones who observes that one-half of the patients over 50 years of age died after one recurrent hemorrhage, and 60 per cent after a second bleeding.

Lest his reader misapprehend that he is recklessly in favor of surgery in bleeding peptic ulcer patients, Gordon-Taylor states: "Every case must be considered on its own merits; there can be no hard and fast rules. Antecedent disease and intercurrent illness, the previous habits of the patient, his physical conformation, and all that constitutes a 'good or bad surgical risk' must be weighed carefully."

Partial gastrectomy has been the usual operation of choice, but no one technique is applicable to all cases. The snail-like closure of the duodenal stump which forms a tampon to a penetrating duodenal ulcer, as devised by Judin, is described in detail.

That the mortality in cases operated upon before the third day is far lower than that in cases operated upon after the sixth day is not a contraindication to late surgery. There have been many dramatic successes in cases thought to be hopeless. The author recalls understandingly the gloomy attitude of the Moscow surgeon, Judin, who for the thirtieth, fortieth, and even the fiftieth time in the postmortem room observed the erosion of an artery in an ulcer crater quite accessible to surgery.

WAYNE CAMEROV, M.D.

**Chesterman, J. T.: Neurogenic Ileus.** *Brit. M. J.*, 1946, 1: 830.

This article is a consideration of ileus due to neuromuscular imbalance, or neurogenic ileus. The problems of neurogenic ileus are discussed under three main headings: (1) intestinal movements and conduction, and their alterations in neurogenic ileus; (2) the sites of action of stimuli producing such alterations; and (3) the factors giving rise to such stimuli in clinical practice.

The gradients theory of polarity proposed by Alvarez to account for phenomena of intestinal motility provides a physiological basis for certain alterations in the neuromuscular balance of the intestine. Various factors may alter the different gradients of the intestine, and these alterations may affect the whole or part of the intestine. There is no reason to doubt that nervous stimuli reaching the bowel may produce such alterations. Alvarez has shown that any stimulation which raises the tonus, activity, or irritability of a segment of the bowel tends to slow the progress of waves and material approaching this segment on the oral side and to hurry the progress of material leaving it on the caudal side. The author believes that experimental and clinical evidence shows the converse to be equally true: that any stimulation which flattens or reverses the gradients of a segment of bowel tends to increase the activity of the segment on the oral side and depress it on the caudal side for a variable distance. This concept he terms the "flattened gradients theory of neurogenic ileus." The local or general flattening of intestinal gradients, with its alterations in the motor function of the bowel, gives a satisfactory explanation of the mechanism of neurogenic ileus. This theory infers that the type of ileus, spastic or distensive, the extent in length of the bowel involved, and the length of time the bowel remains in ileus are due to the stimulus and the condition of the bowel at the time of reception of the stimuli.

Experimental studies were carried out to determine the levels in the neuromuscular mechanism at which ileus may arise. Confirmation was obtained of the value of spinal analgesia in the release of neurogenic ileus which had been produced by iodine

irritation of the peritoneal surface of an area of bowel in anesthetized dogs. The next step was the attempt to induce neurogenic ileus in a dog while under spinal analgesia. It was found that the injection of several milliliters of methylated spirit between the leaves of the mesentery near the bowel margin produced a localized ileus in which the affected bowel distended and became filled with gas and led to a damming back of the intestinal contents on the oral side for varying periods up to several hours. In no case could the effect be attributed to any alteration in the vascular supply of the area. In cats the same procedure carried out under intraperitoneal nembutal analgesia also leads to neurogenic ileus, but in young animals it is often of a spastic rather than of a distensive type. These results have been confirmed in man. These observations lend support to the flattened-gradients theory of neurogenic ileus and also make it reasonable to suppose that so-called sympathetic inhibition of motor activity is not its only cause, but that ileus can arise from stimuli affecting the muscular or nervous mechanism of the bowel.

The factors giving rise to neurogenic ileus in clinical practice are: traumatic, infective, toxemic, and idiopathic.

JOHN L. LINDQUIST, M.D.

Adams, R., and Miller, W. H.: The Surgical Treatment of Intestinal Tuberculosis. *Surg. Clin. N. America*, 1946, 26: 656.

Among a series of 19 surgically treated cases of intestinal tuberculosis, closure of an abdominal fistula was done in 4 cases with recurrence in 3.

Resection of the right colon with the formation of a Mikulicz ileotransverse colostomy and secondary closure was done in 7 cases. Four patients remained well from 9 months to 3½ years later; 1 patient with coexisting carcinoma of the cecum died 2½ years later of carcinomatosis; 1 in whom the intestinal tuberculosis was eliminated revealed progression of the pulmonary disease; and the last patient died 4 years after operation with recurrence.

Resection of the right colon with primary ileocolic anastomosis was done in 3 cases. There was 1 post-operative death. Two patients were well 3 months and 8 months after operation, respectively.

Resection of involved segments of the small intestine with primary side-to-side anastomosis was accomplished in 2 cases and resulted in recession of the symptoms for a year.

Two side-tracking ileotransverse colostomies were done. One patient died 12 days after operation and 1 survived 9 months.

Resection of the sigmoid and a painful associated abscess, with establishment of a permanent colostomy, was accomplished in 1 case. The pain was relieved but perineal drainage has persisted for 2 years.

The authors conclude that tuberculous fistulas rarely can be successfully closed in the presence of active intestinal tuberculosis. A diversionary colostomy should be maintained until the tuberculous process has remained quiescent for at least a year. When there is difficulty in determining the extent of

involvement in the right colon, an ileotransverse colostomy of the Mikulicz type with secondary closure is less hazardous than a primary anastomosis.

Any coexisting active pulmonary lesion should be arrested before an abdominal operation for intestinal tuberculosis is attempted for patients with acute obstruction, internal perforation, or carcinoma.

EDWARD W. GIBBS, M.D.

Baker, H. L., and Halley, H.: Neurofibroma of the Small Intestine with Massive Hemorrhage. *Ann. Surg.*, 1946, 123: 1067.

Benign tumors of the small intestine are comparatively rare. The most common are lipomas, adenomas, hemangiomas, pancreatic rests, cysts, and fibromas. Of these, the fibroma is the rarest.

Two cases of neurofibroma of the small intestine are reported. They were pedunculated in type, and caused very severe intestinal hemorrhage.

The prefix "neuro" used in the term neurofibroma implies a special origin to what is otherwise an essentially fibrous type of neoplasm. The cell concerned is either from the sheath cell about a nerve fiber, or the fibroblast of the delicate framework of connective tissue supporting the nerve fibers. The cells composing these neurofibromas appear and act more like fibroblasts, their presence being associated with the production of fibrils of reticulum and relatively smooth muscle cells, not only individually but in bundles. Therefore, there is a group of similar neoplasms of three different types: the fibroma, arising from the ordinary fibroblasts; the neurofibroma, arising from a special fibroblastlike cell associated with nerve fibers; and the leiomyoma and leiomyosarcoma, arising from smooth muscle cells alone or together with the ordinary fibroblasts.

The demonstration of the point of origin of any particular tumor, as in the 2 cases reported, is often impossible, because of alterations resulting from the growth and size of the tumor when it makes itself clinically apparent. Grossly, a neurofibroma in the small intestine is an encapsulated tumor of variable size and slow in growth, which will produce symptoms which depend on the level at which it occurs, the degree to which it extends into the lumen, and its susceptibility to hemorrhage.

Since benign tumors have been observed most frequently in the ileum and duodenum, these portions of the small intestine should be first examined when an exploratory celiotomy is done. The tumor of the small intestine, so as to be either antimesenteric or to extend into the mesentery. If the tumor is pedunculated, there is a predisposition to intussusception with acute obstruction in a patient previously free of benign tumor. The existence of a pedicle allows ready removal of the tumor, and, however, may result in spontaneous amputation of the possibility of obstruction by some known

The tendency toward bleeding, often pronounced in benign tumors of the duodenum, is associated with the vascularity of the mucosa and of the tumor, with changes in the lining, such as pressure atrophy or ulceration, or with ischemic necrosis of the tumor. Predisposition to hemorrhage occurs with the disseminated focal necrosis incident to scattered thrombi in the small vessels.

Exclusive of other factors, the prognosis is favorable. In the literature examined, no recurrences have been reported. In patients with severe intestinal hemorrhage, especially when bright red blood appears in the stool, and in whom the etiological factor is doubtful, the possibility of the existence of a benign tumor of the small intestine should be considered, and a search made for its presence.

SAMUEL KAHN, M.D.

**Lahey, F. H.:** A Discussion of the Modified Mikulicz Operation for Carcinoma of the Colon and Its Technique. *Surg. Clin. N. America*, 1946, 26: 610.

The author describes his modification of the Mikulicz operation, which is as radical as, if not more radical than, the most primary resections with anastomosis. The method presents no limitations as to the extent of colon or mesentery which can be removed and is applicable to any segment of the colon down to the lower sigmoid. It is possible to decompress the bowel as soon as the operation is completed. In the author's hands the operability rate has been 83 per cent and mortality 2.7 per cent.

The author has employed his procedure in cases of ulcerative colitis (segmental in character), regional ileitis, polyposis, and carcinoma of the colon. The method offers the opportunity to examine the remaining loops of the bowel with the endoscope for the possibility of adjacent polyps.

A palliative resection forms a contraindication to the author's method because the latter complicates and makes less satisfactory the limited period of time available to the patient. For that reason, in this type of palliative operation he has always employed anastomosis of the ileum to that portion of the colon beyond its resected segment.

The Mikulicz operation is especially valuable in patients with fat mesenteries, with fatty epiploic appendages, or with diverticula, in whom an accurate end-to-end anastomosis of the colon is difficult.

The operation is done through either a right or left rectus incision and never through the McBurney or midline incision.

If great difficulty would be encountered in peritonealizing the right gutter region of the hepatic flexure, no attempt is made to do this.

When the lesion is in the lower loop of the sigmoid where an inadequate amount of bowel tube remains below for the application of the modified Mikulicz procedure, the abdominosacral type of operation rather than any type of resection with pelvic anastomosis is to be preferred.

The second stage closure of the Mikulicz operation has been 100 per cent successful as far as persistent

fistulas are concerned. A minimum time of 2 months should elapse before the second stage closure of the enterostomy is attempted.

JOSEPH K. NARAT, M.D.

**Sugarbaker, E. D.:** Coincident Removal of Additional Structures in Resections for Carcinoma of the Colon and Rectum. *Ann. Surg.*, 1946, 123: 1036.

As a result of the tendency toward increasing radicalism in dealing with carcinomas of the large bowel, more frequent attempts are being made to remove tumors which have definitely invaded the adjacent structures, or are suspected of doing so.

Forty-two such cases are presented, in which additional organs were removed in order to accomplish the removal of a rectal or colonic cancer. The poorer general condition of these patients as well as the increased extent of the operations is reflected in an appreciably higher operative mortality.

Justification for such procedures is found in the fact that 19 of 34 patients who survived the operation are still living after considerable periods of time.

SAMUEL KAHN, M.D.

#### LIVER, GALL BLADDER, PANCREAS, AND SPLEEN

**Beavan, T. E. D., and Duncan, G. W.:** Congenital Atresia of the Common Bile Duct. *Brit. J. Surg.*, 1946, 33: 378.

The case of a 5 weeks old child with congenital atresia of the common bile duct is described. Cholecystogastrostomy was performed with a successful outcome. This was the ninth successful case reported in the literature, and apparently the first in England.

In this case the differential diagnosis was not difficult. It was important to exclude icterus gravis neonatorum. The late onset of the jaundice, together with the fact that the mother and child were both rhesus-positive, and the absence of an erythroblastic picture in the blood film, ruled out icterus gravis neonatorum, the most important alternative. The presence of obstructive jaundice would not be conclusive evidence against this diagnosis, because in certain of the more severe cases of this disease, the blood destruction is so great that an obstructive jaundice is caused by the blocking of the bile ducts. Anemia may occur as a secondary manifestation in any infection; therefore it is not a helpful diagnostic feature. Congenital syphilis would only exceptionally give rise to a severe jaundice; a mild degree of jaundice, coupled with hemorrhages, a rash, enlarged liver and spleen, and roentgenological changes in the long bones, would be expected. Acholuric jaundice rarely gives rise to severe jaundice of the obstructive type at such an early age; a mild jaundice with anemia and increased fragility and microspherocytosis are more commonly found. Physiological icterus does not really enter into the question as it clears up early and is not severe. Jaundice due

to sepsis is uncommon, and the severe constitutional disturbance and the presence of bile in the stools would exclude it. Infective hepatitis has not been reported in so young an infant. The long incubation period would at least make it unlikely to occur before the child was from 4 to 6 weeks old, unless the mother was also infected and then she would also become jaundiced. The Van den Bergh test would be biphasic. Obstruction by a mucus plug can only be diagnosed at operation, as it presents the same clinical picture.

CHARLES BARON, M.D.

**Aldis, A. S.: Injuries to the Pancreas and Their Surgical Treatment.** *Brit. J. Surg.*, 1946, 33: 323.

Injuries to the pancreas are uncommon. Most injuries of the pancreas are associated with extensive injuries to other abdominal viscera, the liver, spleen, and stomach being most commonly involved, and thus they are often beyond the reach of surgical aid. However, the close apposition of the body of the pancreas to the unyielding body of the first lumbar vertebra makes it possible for the pancreas to be crushed, ruptured, or torn across in crush injuries of the upper abdomen, and especially if the trauma is a very sudden one which produces its effects before the abdominal musculature has had time to guard against the blow. In such cases the pancreas may be injured apart from any other viscus. The trauma which may give rise to injuries may be surprisingly slight and is often not sufficient to produce any wounding or bruising of the perietes. This is probably a reflection of the flaccid condition of the abdominal musculature at the time of the accident, which in itself made the injury possible. Such an injury may vary from complete rupture of the gland to simple bruising, and naturally the condition of the patient will vary accordingly. In the severe injuries with complete rupture there will be no doubt in the mind of the surgeon that laparotomy will be required, although no exact preoperative diagnosis can be made. In this connection attention may be drawn to the importance of shoulder-tip pain on the left side in injuries to the pancreas which produce effusions into the lesser sac.

Trauma may produce late results in the form of a cyst or pseudocyst of the pancreas. In all the reported series, cysts following inflammatory conditions of the pancreas are very much commoner in women than in men, being commonly associated with chronic cholecystitis and cholelithiasis; but those resulting from trauma occur more commonly in males, in association with the greater hazards of their occupations.

All 3 of the cases reported in the present article were in males. The time interval between the infliction of the trauma and the appearance of the cyst is quite variable, from a few days to more than a year, but many cysts seem to develop within a month or 6 weeks of the injury, and this period of time may be taken as typical. The pathological processes which lead to the formation of a cyst in such typical cases would appear to be as follows:

Bruising of the pancreas produces a hematoma beneath the capsule into which the damaged pancreatic cells release their ferments. Fat necrosis is often seen in immediate operations upon pancreatic injuries. The trypsin in the juice, while normally inactive as secreted, becomes activated by contact with damaged and devitalized tissues and digests the clot, thus giving rise to further bleeding from the thin walled pancreatic vessels. This process is repeated and the cyst enlarges as a result of repeated hemorrhages. The digestion may go on until the pancreatic duct is involved, when the size of the cyst will be rapidly increased by the admixture of pancreatic juice.

No doubt there are many variations of this process and the cysts of rapid onset are probably due to rupture of the capsule of the pancreas, frank hemorrhage, and escape of pancreatic fluid into the lesser sac of the peritoneum. The characteristic swelling in the left hypochondrium may be easily seen as well as felt. Pancreatic cysts may extend in various directions, above the stomach, between the stomach and the colon, or downward behind the colon into the pelvis, but by far the most common are those between the stomach and colon, which produce the classical appearance of swelling in the epigastrium or left hypochondrium.

Of the accessory methods for confirming the clinical diagnosis, the most consistently valuable is the barium meal roentgenographic examination, which will show a variety of deformations of the stomach or duodenum produced by the pressure of the large extragastric mass.

Surgery holds out 3 possible and satisfactory forms of treatment for cysts of the pancreas. The three types of operation which have been advocated and applied are excision, marsupialization and drainage, and primary anastomosis between the cyst and the stomach or small intestine. Of the first it may be said that, while the most radical, it is seldom practicable for technical reasons. The second method has stood the test of time and experience and probably represents the standard procedure at the present day. It has the merits of being easy and of universal application, and in fully 80 per cent of cases it produces a rapid cure of the condition. On the other hand, however, recurrences are by no means unknown, and in some cases in which there is major damage to the pancreatic duct or ducts the drainage of the cyst may be followed by the development of a troublesome and intractable pancreatic fistula, although in most cases the fistula will close spontaneously in course of time. The third method is of more recent origin and has been introduced with a view to overcoming the objections which have been advanced to the method of treatment by marsupialization and drainage. It does not yet have the weight of experience behind it that marsupialization and drainage have, but so far as it has been tried it is probably the most satisfactory treatment that we have to date. Of the 7 cases reported in this article 5 were treated by marsupialization, 1 by evacuation

The tendency toward bleeding, often pronounced in benign tumors of the duodenum, is associated with the vascularity of the mucosa and of the tumor, with changes in the lining, such as pressure atrophy or ulceration, or with ischemic necrosis of the tumor. Predisposition to hemorrhage occurs with the tumor. Predominant focal necrosis is incident to thrombi in the small vessels.

Exclusive of the small vessels, the prognosis is favorable. In the literature examined, no recurrences have been reported. In patients with severe intestinal hemorrhage, especially when bright red blood appears in the stool, and in whom the etiological factor is doubtful, the possibility of the existence of a benign tumor of the small intestine should be considered, and a search made for its presence.

SAMUEL KAHN, M.D.

Lahey, F. H.: A Discussion of the Modified Mikulicz Operation for Carcinoma of the Colon and Its Technique. *Surg. Clin. N. America*, 1946, 26: 610.

The author describes his modification of the Mikulicz operation, which is as radical as, if not more radical than, the most primary resections with anastomosis. The method presents no limitations as to the extent of colon or mesentery which can be removed and is applicable to any segment of the colon down to the lower sigmoid. It is performed by decompressing the bowel as soon as the operation is completed. In the author's experience, the rate has been 100 per cent.

The author has employed his procedure in cases of ulcerative colitis (segmental in character), regional ileitis, polyposis, and carcinoma of the colon. The main loops of the bowel with the endoscope for the possibility of adjacent polyps.

A palliative resection forms a great part of the author's method and makes

A palliative resection forms a contraindication to the author's method because the latter complicates and makes less satisfactory the limited period of time available to the patient. For that reason, in this type of palliative operation he has always employed anastomosis of the ileum to that portion of the colon beyond its resected segment.

The Mikulicz operation is especially indicated in patients with fat mesenteries, especially in those with appendices.

The operation beyond its resected segment. The Mikulicz operation is especially valuable in patients with fat mesenteries, with fatty epiploic appendages, or with diverticula, in whom an accurate end-to-end anastomosis of the colon is difficult. The operation is done through either a left or midline incision and never the right. If great

The operation is done through either a right or midline incision and never through the McBurney

If great difficulty would be encountered in peritonealizing the right gutter region of the perispleurum, no attempt is made to do this. When the lesion is in the lower lobe, where an inadequate area of perispleurum is available, the right lung is removed and the right pleural cavity is closed by suturing the parietal and visceral pleura together.

When the lesion is in the lower loop of the sigmoid below the application of the bowel tube remains rather than any type of resection with pelvic anastomosis is to be preferred.

The second stage closure of the Mikulicz operation has been 100 per cent successful as far as persistent

fistulas are concerned. A minimum should elapse before the second stenterostomy is attempted.

Joseph

Sugarbaker, E. D.: Coincident Functional Structures in Resection of the Colon and Rectum. 123: 1036.

As a result of the tendency to radicalism in dealing with carcinoma of the bowel, more frequent attempts are made to remove tumors which have definite adjacent structures, or are situated in the sigmoid colon, or are of the type of carcinoma of the rectum.

Forty-two such cases are presented in which the removal of a rectal or colonic carcinoma was performed in the general condition of these patients. In the majority of cases, an increased extent of the operations was necessary, and the results were appreciably higher than those reported by other workers.

fact that 19 of 34 patients who are still living

SAMPLE

LIVER, GALL BLADDER, PANCREAS  
AND SPLEEN

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The case of a 5 weeks old child with atresia of the common bile duct is described. Cystogastrostomy was performed with a good outcome. This was the ninth success reported in the literature, and apparently the first in England.

In this case the differential diagnosis was difficult. It was important to exclude neonatorum. The late onset of the both rhesus-positive, and the absence of a blastic picture in the blood film, ruled out neonatorum, the most important presence of obstructive jaundice. The conclusive evidence against this diagnosis in certain of the more severe cases of the blood destruction is the presence of jaundice in the blood destruction is the presence of

The presence of obstructive jaundice in the newborn, the most important conclusive evidence against this diagnosis in certain of the more severe cases of the blood destruction is so great that an anemia is caused by the blocking of the any infection; therefore it is a secondary manifestation. Congenital syphilis would not only give rise to a severe jaundice; a mild jaundice, coupled with hemorrhages, a enlarged liver and spleen, and roentgenological changes in the long bones, would be expected. A jaundice rarely gives rise to severe obstructive type at such an early age; a mild jaundice with anemia and increased fragility and spherocytosis are more commonly found. Icterus does not really enter into the picture as it clears up early and is not severe. Jaundice

discussed under the headings: (1) diet, (2) drugs, and (3) other measures. Since the volume of the secretion is largely governed by the secretin mechanism, which is in turn dependent upon the motility of the stomach and the acidity of its contents, any measures which will lessen these might be expected to bring about a reduction in the volume of secretion.

Wohlgemuth instituted his dietary regimen for pancreatic fistulas and this has remained the standard since his day. His method was briefly to give a high fat, low carbohydrate diet together with plentiful doses of sodium bicarbonate and atropine, all of which measures are designed to diminish gastric acidity and motility. Many have reported favorably on this regime, but more recent and accurate measurements in the human being have cast some doubt on its effectiveness. With regard to drugs, ephedrine appears to be the most satisfactory for clinical use. There are other drugs, as for example physostigmin, which have a greater effect in diminishing the pancreatic secretion, but they all have unpleasant side reactions of one sort or another which make them undesirable for clinical use. Some writers have reported favorably on the effect of deep x-ray therapy in diminishing the pancreatic secretion and producing closure of fistulas, but the consensus of opinion among most recent writers who have tried it is that it has little or no effect, and the same may be said for the use of sclerosing fluids injected into the fistula. Surgery should not be considered for at least 6 months if the patient's health is not being impaired by the fistula, as many fistulas have closed after several months. If surgery is deemed advisable, the fistula may be dissected out and implanted into an adjacent viscus; the stomach, gall bladder, and jejunum have all been used for this purpose. Of these, the stomach has found most favor and has much to commend it because of its accessibility and the fact that the tryptic activity of the juice which might digest the suture line is immediately destroyed by contact with the acid secretion of the stomach. No untoward effects upon the digestive processes have been observed. However, "prevention is better than cure" in surgery as in medicine, and the fact that most pancreatic fistulas follow upon the drainage of pancreatic cysts must compel the question as to whether primary anastomosis of pancreatic cysts should not replace marsupialization and drainage as the standard treatment for pancreatic cysts.

CHARLES BARON, M.D.

Sacharow, G. P., and Rossysky, D. M.: The Treatment of Diabetes Mellitus without Insulin. *Vrachebnoe Delo*, 1946, 1, 2: 39.

Despite the universally well known treatment of diabetes mellitus with insulin, the possibility of influencing this condition favorably by other means should not be ignored. For the past 10 years the authors have been using, in the place of insulin, a special cytotoxic serum prepared from the pancreatic glands of animals which have been previously immunized against extracts of the human pancreas

procured from fresh corpses. This preparation is injected into the diabetic patient in small doses, in courses of from 20 to 30 injections and at intervals depending more or less upon the reactive capacity of the patient. At first these injections were intended as a means of stimulating the islands of Langerhans; but since ameliorating effects were noted on depancreatized experimental animals, the question came up as to whether the effect might not be exerted more generally on the entire substratum of the disease. Since there is a hypophyseal form of hyperglycemia and glycosuria the authors admit the possibility that the effect of their preparation might be procured indirectly by way of the hypophysis or other body glands (cortex of the suprarenals). It is also admitted that there is a reasonable basis for the fear that a stimulating influence on the islands of Langerhans, which are already diseased, might result in their eventual exhaustion; however, this expectation has not as yet been borne out in practice.

Although the authors do not as yet have data on their patients covering a sufficient period of time to justify giving individual case reports, they have observed a lowering of the hyperglycemia and glycosuria with their preparation, which has been similar to that obtained with insulin and the effects have been even more enduring. In fact they have had 2 patients under observation for 8 years who have not received either their preparation or insulin for the past 5 years, the original amelioration having lasted up to the present.

In any event, the authors believe that the time is now ripe for the profession to devote its attention to the possibilities inherent in the new methods of treatment of diabetes mellitus, and recommend that the problems involved be studied in the larger institutions.

JOHN W. BRENNAN, M.D.

Pompen, A. W. M., Jansen, C. A. L., and Dhont, J.: Adenoma of the Islets of Langerhans and Pregnancy. *Acta med. scand.*, 1946, 124: 334.

The authors report the case of a 35 year old woman who developed symptoms of hyperinsulinism 13 days after confinement in her second pregnancy. There were repeated attacks of loss of consciousness frequently in the early afternoon and also in the early morning. The attacks were accompanied by profuse perspiration and salivation. The blood sugar levels during attacks varied from 50 to 60 mgm. per cent and the attacks responded to the intravenous injection of dextrose solution. A provisional diagnosis of hypoglycemia during lactation was made and lactation was brought to an end. However, significant improvement did not occur when lactation ceased. After the patient returned home there was little improvement for a long time, but halfway through the third pregnancy distinct improvement occurred. Nine days after delivery the hypoglycemic attacks occurred more severely than following the second delivery.

A diagnosis of a hypoglycemic state due to an islet cell tumor of the pancreas was made. Such a tumor



of the cyst and closure of the abdomen, and x by anastomosis with the stomach over a rubber tube.

Pancreatic fistulas raise many problems which have engaged the attention of a number of investigators and which may be summarized as follows: the volume and control of pancreatic secretion, the cause of death in fatal cases and of pancreatic asthenia in less severe ones, the degree of importance of the external secretion of the pancreas to normal digestion, the enzymatic activity of pancreatic secretion, and the treatment of pancreatic fistulas.

It is generally acceded that the pancreatic secretion is under the control of both nervous and humoral influences. The humoral control is effected by means of secretin which is liberated from the duodenum in response to the discharge of the acid contents of the stomach into it. The secretin thus thrown into the blood stream stimulates the pancreas to produce a large volume of secretion rich in sodium bicarbonate. Stimulation of the vagus, on the other hand, has a much smaller effect on the volume secreted, but produces a fluid which is rich in digestive ferments. Thus it will be seen that the volume and alkalinity of the secretion are largely under humoral control while the digestive activity is under nervous control. The secretin mechanism contains within it the elements of an automatic regulator or cut out, for the alkaline secretion poured out in response to the acid chyme entering the duodenum rapidly brings about its neutralization and consequently the cessation of the stimulus. It is quite clear that in cases of fistula this automatic control is rendered inoperative. The pancreas responds to the secretin stimulus, but the resultant flow of fluid does not reach the duodenum.

The cause of death is not yet sufficiently clear and is almost certainly due to a number of contributory causes. The dehydration is an obvious factor. Human pancreatic fistulas may secrete up to 2,000 c.c. ( $3\frac{1}{2}$  pints) of fluid in a day, which represents a very substantial fluid loss. In addition to this there is the fluid lost in the vomiting which is such a common concomitant of the condition. This dehydration is rapidly reflected in the sunken eyes and inelastic skin of the sufferer. Pancreatic fluid contains an appreciable quantity of protein, albumin, and globulin, and this mounts up in the large volume secreted to produce a serious drain on the plasma proteins. Pancreatic fluid also is a markedly alkaline secretion—the pH of the specimen recorded was 9. This alkalinity is due to the high sodium bicarbonate content, and it might be that such a constant drain in alkali would produce a significant acidosis. While there is no doubt that it does cause some acidosis, the effect should not be overestimated. In the first place this is counterbalanced to some extent by the frequent concomitant vomiting, and also there is evidence to show that much of the bicarbonate is produced locally in the pancreas as a product of the metabolism of its cells and is not derived from the blood. This is in keeping with the surprisingly slight changes in blood chemistry which have been

repeatedly reported even in patients who were gravely ill. However, while the blood chemistry changes are slight and may be masked by the concentration of the blood, this does not mean that such changes which are present are not very important. This discussion of blood chemistry may seem to be unduly academic, but at least it has an important practical significance as it emphasizes the importance of maintaining the fluid and sodium reserves of the body in all such cases. While there is no doubt that the main factors contributing to the mortality and morbidity of pancreatic fistulas are the anhydremia and blood changes outlined, there remains an uneasy feeling that this is not perhaps the whole story.

The pancreas has been successfully extirpated in the human being without impairment of the digestion, and it may well be asked whether the external secretion is of any vital importance in the digestive processes. The occurrence of fatty diarrhea in cases of pancreatic fistula and other pancreatic diseases is quite inconstant and apparently quite capricious, being unrelated to the severity of the condition (some cases of partial fistula have severe steatorrhea, while other cases of total fistula have no such symptoms). Probably in most people the succus entericus together with the bile is quite capable of carrying on the digestive process to completion if the pancreatic juice is wanting, and thus we have but another example of the prodigality with which the body is supplied with alternative mechanisms to take the place of any which may be temporarily or permanently put out of action. No doubt, however, there are some individuals who are not able to compensate for the loss of pancreatic secretion, and in these the withdrawal of this fluid represents an irreparable loss resulting in serious digestive impairment.

Eighty per cent of such fistulas close spontaneously in due course, and such closure has been noted even up to a year after the fistula has been established. Treatment in the first instance should, therefore, be conservative and should be directed toward: (1) the restoration and maintenance of fluid requirements and normal blood chemistry, (2) the protection of the wound when digestive activity is a feature of the condition, and (3) diminution in the volume of the secretion to encourage closure. The second is often no problem at all, but if digestion of the wound is troublesome probably the best method of treatment is that devised by Caryl Potter (1929) for the treatment of duodenal fistulas. This is based on the fact that trypsin is only active in an alkaline medium, and the method consists in irrigating the wound with a continuous drip of N/10 hydrochloric acid and dressing it with gauze soaked in 10 per cent Witte's peptone to absorb any tryptic activity which may still be left. Less severe cases can be satisfactorily handled by protection of the skin with liberal applications of vaseline or aluminum paste. The third objective of conservative treatment, namely, to diminish the secretion in order to favor closure of the fistula, may be conveniently

discussed under the headings: (1) diet, (2) drugs, and (3) other measures. Since the volume of the secretion is largely governed by the secretin mechanism, which is in turn dependent upon the motility of the stomach and the acidity of its contents, any measures which will lessen these might be expected to bring about a reduction in the volume of secretion.

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A diagnosis of a hypoglycemic state due to an islet cell tumor of the pancreas was made. Such a tumor

was found in the head of the pancreas and was removed. Since removal of the tumor there has been no recurrence of the hypoglycemic state. The patient subsequently went through a pregnancy and the child, though normally developed, was born dead. Following this delivery there was no return of the symptoms.

EARL O. LATIMER, M.D.

### MISCELLANEOUS

Harvey, E. N., Whiteley, A. H., Grundfest, H., and McMillen, J. H.: Piezoelectric Crystal Measurements of Pressure Changes in the Abdomen of Deeply Anesthetized Animals during Passage of a High Velocity Missile. *Mil. Surgeon*, 1946, 98: 509.

Rapid pressure changes accompany the passage of a high-velocity missile through the body. Shock arises when the missile strikes tissue; a high pressure exists on the face of the moving missile; and, finally, there are pressure changes which accompany the formation and pulsation of the temporary cavity behind the missile. In order to measure accurately these pressure changes in small animals, it is necessary to use a recording device of small size the presence of which will not greatly disturb the pressure gradient. It is also essential that the response of the pressure gauge be instantaneous, since some of the pressure changes must be measured in microseconds. For this purpose the tourmaline piezoelectric gauge is ideal.

To measure pressures in the body the tourmaline crystal gauge is placed in the stomach of a deeply anesthetized cat, which is then shot through the lower part of the abdomen. With the development of hydrostatic pressure, electric charges which are proportional to the pressure appear on the tourmaline surface. The charges are amplified and applied to the vertical plates of the cathode ray oscilloscope with a single horizontal sweep to record the time axis. The fluorescent trace of the electron beam on the face of the tube is then photographed with a wide aperture lens on Super XX panchromatic film.

The pressure changes during the passage of a high-velocity missile through the abdomen of a deeply anesthetized cat have been correlated with events in the body by microsecond roentgenograms and high speed motion pictures. Positive pressures of hundreds of pounds per square inch, lasting a few microseconds, result from the shock wave which arises when a missile strikes the body wall. This wave then travels through tissue with a velocity of approximately 4,800 feet per second. The shock wave may be reflected from air pockets, bone, or tissue surfaces. A new shock wave will also form whenever the missile traverses a gas pocket. No characteristic shock wave pressure pattern is produced, but each animal will differ, according to the gas distribution in the alimentary tract and the course of the missile. A series of pressure responses have also been recorded by a crystal gauge in the stomach during a shot through the thigh of a cat.

Slow pressure changes, measured in tens of pounds per square inch and in milliseconds, follow the shock wave pressures after a shot through the abdomen. They are connected with the temporary cavity behind the missile. With the expansion of this cavity, a subatmospheric pressure develops that becomes positive as the cavity collapses. Then two small pressure oscillations occur.

Microsecond roentgenograms show no second expansion after the collapse of the cavity, although vigorous abdominal movements occur. The cavity is believed to consist almost entirely of water vapor, which collapses completely, except for a few pockets of gas responsible for the two small pressure oscillations measured above. Pressure records, microsecond roentgenograms, frames from motion pictures, and spark shadowgrams of shock waves in water illustrate the findings. JOHN L. LINQVIST, M.D.

Gillis, L.: Hernia through the Foramen of Winslow. *Lancet*, Lond., 1946, 2: 48.

Hernia through the foramen of Winslow is rare and has a very high mortality. It occurs in two forms: in one the hernia passes into the foramen of Winslow and remains in the lesser sac and in the other it re-enters the peritoneal cavity through the gastrohepatic omentum. Either the small intestine or the large intestine may enter the foramen of Winslow.

The present case may throw some light on both the predisposing factors and the anomalies which are said to exist.

A rigger, aged 41, was admitted to the hospital with a history that he had been seized with a sudden severe pain in the epigastrium while at stool. The pain was sharp and continuous, did not radiate, and had not altered in character since its onset. He had vomited 4 times before admission.

On examination he was in a severe state of shock and obviously in great pain. There was tenderness in the epigastrium and some guarding, but no rigidity. Acute intestinal obstruction or perforation was tentatively diagnosed.

Under general anesthesia the patient was operated on. The peritoneal cavity was opened through a midline incision. There was some bloodstained fluid present in the peritoneal cavity. No perforation could be found, but there was an unusual band running across the posterior abdominal wall, toward the right hypochondrium. This consisted of small intestine with its mesentery. As this was abnormal anatomically, the question arose whether this was not some form of transposition of the viscera. Further investigation showed that it was an internal hernia into the foramen of Winslow.

The bowel could be coaxed back into the greater sac by stretching the foramen of Winslow with the fingers, by pressure on the gastrohepatic omentum, and by gentle traction on the entering loop.

The loop, when reduced, was found to be about 18 inches of jejunum; it was purple and frayed but not devitalized. The proximal loops were distended, and the distal loops were collapsed. Resuscitative meas-

ures with warm towels improved the condition of the bowel, except for an area about the size of a shilling in the mesentery.

The patient made an uninterrupted recovery and is quite well to date.

The history of sudden pain while at stool suggests that the increase of intra-abdominal pressure allowed the small intestine, attached to an abnormally long mesentery, to be driven into the foramen of Winslow.

HARRY W. FINK, M.D.

Hamilton, I., and Hardy, J. E. S.: Hernia through the Foramen of Winslow Emerging through the Gastrohepatic Omentum. *Med. J. Australia*, 1946, 1: 805.

A 29 year old male fitter in good health previously was seized suddenly with agonizing pain and attacks of vomiting. His temperature was normal but his pulse was only 52 per minute. The initial diagnosis was ruptured peptic ulcer, which because of a change in symptoms was later changed to obstruction of the small bowel and more specifically to strangulation of an internal hernia.

At operation, 21 hours after the onset, through an upper abdominal paramedian incision on the right side and after displacement of the rectus laterally,

coils of dark blue, distended small gut could be seen, and a considerable amount of hemorrhagic serous effusion continued to well into the wound. The distended loops were traced upward and downward, and it became obvious that both limits of the bowel disappeared upward between the stomach and liver. On further investigation it was discovered that the coils passed through a rent in the lesser omentum into the lesser sac. With retractors and packs the foramen of Winslow was sought, and it was discovered that two coils of gut passed through the opening. Attempts to reduce these failed at first, but after digital dilatation of the foramen the gut could be extricated from the lesser sac and returned to its rightful position. About 3½ feet of small bowel had been involved, the involvement extending downward from about 3 feet from the duodenojejunal flexure. Both afferent and efferent loops were constricted at the foramen. The congested gut was delivered and wrapped in moist, warm saline packs, and the lesser omentum was inspected. An oval hole, about 2½ inches by 1½ inches was seen. This was sutured with catgut. The small bowel was returned to the abdomen and the wound was sutured in layers.

The postoperative course was stormy but the patient made a good recovery. HARRY W. FINK, M.D.

# GYNECOLOGY

## UTERUS

Kahanpää, V.: The Pathogenesis of Ovarian Endometriosis (Ueber die Pathogenese der Ovarialendometriose). *Acta obst. gyn. scand.*, 1946, 26: 139.

Although the implantation theory of endometriosis proposed by Sampson is rather widely accepted at the present time, there is still controversy concerning the mechanism of implantation and the pathogenesis of hemorrhagic cysts of the ovary. The author studied histological preparations of operative specimens in 6 cases of ovarian endometriosis and hemorrhagic cysts obtained at the Women's Clinic in Helsinki. Serial sections were not made but samples of tissue were taken from each ovary and cyst and stained with hematoxylin van Gieson stain. The case histories, operative findings, and significant photomicrographs are presented.

Typical endometrial tissue was found both in proximity to and at a distance from the hemorrhagic cysts. Likewise, typical endometrial tissue was found on the surface of, and penetrating deeply into, the ovarian tissue. One specimen, removed at the beginning of menstruation, presented the appearance of a hemorrhagic cyst in the process of early development, the cyst cavity containing epithelium, blood, and secretion. In several instances a new observation was made, namely, that primary endometriosis implantation may occur in the corpus luteum.

The observations made in this study are thoroughly in accord with Sampson's theory concerning the origin of ovarian endometriosis and the gradual development of hemorrhagic cysts from the endometrial tissue. It appears that primary implantation in the ovary may occur in a recently ruptured follicle or a young corpus luteum. The rupture of the follicle provides a break in the tunica albuginea, while the local blood imbition of the tissues and the uneven surface favors the implantation and development of the endometrial fragment in the new site.

With respect to the viability of endometrial fragments arriving at the ovary, it is probable that these fragments do not originate from the uterine mucosa during menstruation, but rather that they are derived from tubal endometrium during the menstruation interval, as suggested by Philipp and Huber. Following primary implantation in the ovary, propagation may occur by direct growth in continuity, or secondary implantation may occur from rupture of hemorrhagic cysts during the menstruation interval.

JOHN L. LINQOIST, M.D.

Gianaroli, L.: A Contribution to the Problem of Serological Diagnosis of Cancer of the Uterus (Contributo allo studio della diagnosi sierologica del cancro dell'utero). *Riv. ital. gin.*, 1943, 26: 429.

The method of Hirsfeld and Halber (with minor modifications) was utilized for serological diagnosis

in a series of 56 cases of uterine or vaginal carcinoma, and a control group of 90 cases. The antigen was prepared from known carcinomatous tissue by alcoholic extraction, in several dilutions. Fresh guinea pig serum was employed as complement. Another method of diagnosis was accomplished with the use of rams' red cells with a specified hemolysin. The quantities and technique were those commonly adopted for the Wassermann reaction. Readings were taken at 12 and 24 hours.

Of the experimental group, 24 patients gave strongly positive reactions, 23 positive, and 9 weakly positive. The reactions of 84 of the control group were negative. Although these results are more consistent than those obtained by other methods, the specificity of the complement fixation method is not established.

In view of the small incidence of positive reactions among the control group, however, the usefulness of the method is demonstrated, if not for the discovery of early lesions, at least as corroborative evidence in cases of doubtful lesions.

EDITH B. FARNSWORTH, M.D.

Ayre, J. E.: Vaginal and Cervical Cytology in Uterine Cancer Diagnosis. *Am. J. Obst.*, 1946, 51: 743.

This report consists of an analysis of 100 cases of genital malignancy studied in the Gynecologic Cytology Division of the Royal Victoria Hospital. Excellent colored photomicrographs of representative cases are presented.

In the 100 cases giving a tissue diagnosis of malignancy, the cytology smears showed an average error of 6 per cent. Smears taken routinely from the external cervical os have been found to be more reliable for diagnosis than vaginal smears. An interesting observation was that many of the cases of malignancy in the postmenopausal age group showed evidence of associated estrogenic activity.

The smear technique has been shown to be of value in detecting cancer at an early stage. It has proved helpful too in benign cases simulating malignancy clinically. Negative cell smears in such cases have been proved correct by biopsy. The method has also been found to be of value in assessing radiation therapy.

A new technique, the centrifuge cytology technique, is presented briefly with illustrations.

EDWARD L. CORNELL, M.D.

Fremont-Smith, M., Meigs, J. V., Graham, R. M., and Gilbert, H. II.: Cancer of the Endometrium. *J. Am. M. Ass.*, 1946, 141: 805.

The authors present a case treated with large amounts of estrogenic substance almost continuously for 8 years with a final diagnosis of carcinoma of the endometrium. They found atrophic vaginal epithelium after estrogen was withdrawn, and supposed

that the patient was producing little or no estrogen, but after the administration of extrinsic estrogens she developed endometrial cancer.

They reviewed the literature in regard to the relationships between estrogens and cancer of the breast, and cancer of the endometrium. In regard to the first relationship, it was noted that when Lacasagne gave diethylstilbestrol, chemically unrelated to the natural estrogens, to male mice it caused cancer. All authors agree that in addition to estrogenic stimulation of the breast, two other factors are essential for the production of mammary cancer in mice; these are (1) a "milk factor" and (2) a hereditary factor. There have been several reports of cancer of the breast which occurred in women under estrogen therapy. In regard to the relationship between estrogens and cancer of the endometrium, it is noted that no report of endometrial carcinoma in animals subjected to estrogen treatment has appeared, but cancer of the cervix has been produced by estrogens.

In man, carcinoma developing on the basis of hyperplasia has been particularly observed by Novak and Yui. They found hyperplasia in 25 of 104 cases of endometrial cancer. Randall believes that when postmenopausal bleeding occurs, the woman who has experienced menorrhagia during the climacterium presents a  $3\frac{1}{2}$  times greater chance of having adenocarcinoma of the uterus than does one who has had no excessive bleeding during this period.

CATHERINE B. HESS, M.D.

### EXTERNAL GENITALIA

Siegler, S. L.: A New Method of Treatment for Vaginitis and Cervicitis. *Am. J. Obst.*, 1946, 52: 1.

A new antivaginitis sulfathiazole polyethylene glycol acid jelly is described. The jelly is nonirritating, nonstaining, and of an agreeable odor. It spreads over the cervical and vaginal surfaces and is completely soluble in the secretions. It does not easily leak out of the vagina unless the discharge is profuse. It has a mild but definite astringent effect on the vaginal mucosa.

Use of the jelly has resulted in excellent control of vaginitis of trichomonal, monilial, gonococcal, and nonspecific origin in 93 per cent of the cases observed, and in permanent cure in 83 per cent. Use of the jelly alone has given good results in the management of cervical infections in 22 per cent of the cases treated.

The period of convalescence can be markedly shortened, and annoying symptoms reduced by use of the jelly before and after such procedures as conization, coagulation, cauterization, plastic repair, and other intravaginal surgery. Healing was complete within an average time of 5 weeks with a minimum of sequelae. The convenience and simplicity of the single dose disposable paper applicator facilitates intravaginal medication both in the office and in the patient's home.

EDWARD L. CORNELL, M.D.

### MISCELLANEOUS

Deter, R. L., Caldwell, G. T., and Folsom, A. I.: A Clinical and Pathological Study of the Posterior Female Urethra. *J. Urol.*, Balt., 1946, 55: 651.

The purpose of this study by the authors was to emphasize the importance of the glandular structures encountered in the posterior female urethra. We have very meager knowledge of the embryology of the female urethra. According to Evatt, the female urethra is the counterpart of the whole prostatic urethra in the male. Histologically, glands were found in 92 per cent of the urethras studied. The main characteristic of these glands was that they appeared to be tubular glands and compound tubular glands. The closer to the bladder the sections were taken, the greater was the number of glands that were seen. In 100 per cent of the specimens showing glands their location was found to be on the lateral and posterior surfaces.

The symptoms of posterior urethral disturbances were frequency, more diurnal than nocturnal, and bladder irritability. Cystoscopic examination shows intense redness of the mucous membrane with small elevated areas which appear to be cystic and give the urethra a granular appearance.

These studies lend support to the opinion of some urologists that the pathological changes which take place in the posterior female urethra are produced by infection in the posterior urethral glands. It is also believed that the hormones play some part in the etiology. These changes are frequently found just preceding or just after the onset of puberty, in post-nuptial cases, in pregnancy, and at or after the menopause.

CATHERINE B. HESS, M.D.

Rauramo, M.: A Rapid and Easily Performed Method of Operation in Cases of Urinary Incontinence (Au sujet d'une méthode d'opération rapide et facile à pratiquer dans les cas d'incontinence urinaire). *Acta obst. gyn. scand.*, 1946, 26: 129.

The author describes and illustrates a rapid and easily performed method of operation in cases of urinary incontinence.

The procedure described is a modification of the operation published by Berkow in 1941 (*Am. J. Obst.*, vol. 41).

The author considers this method an improvement of the procedure of transplanting the urethral orifice as advocated by Pawlik, Dudley, and others.

The essential point in the procedure consists in the careful detachment of the lower part of the urethra and its transplantation much higher, just beneath the clitoris, where it is fixed. In addition, the urethra is strengthened throughout its entire length by a supporting suture of the muscles of the urogenital diaphragm, which recalls notably the procedure of Opitz. Both Berkow and Burger (*Zbl. Gyn.*, 1943), who modified the procedure, operated through a triangular incision, the apex of which was immediately beneath the clitoris and the lateral

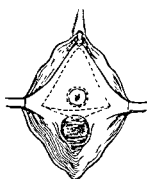


Fig. 1

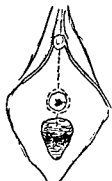


Fig. 2

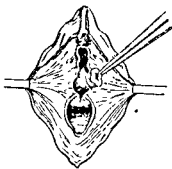


Fig. 3

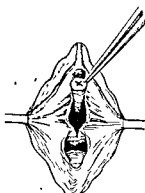


Fig. 4

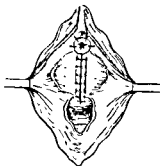


Fig. 5

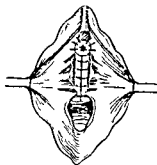


Fig. 6



Fig. 7

angles of which were slightly below and lateral to the urethral orifice. In this area the mucosa was removed except for the little collar left around the urethra (Fig. 1).

The author has tried this method for about 2 years in several cases and the results seemed to be of such value that he wishes to call attention to this simple procedure. By virtue of his own experience, he modified the operative procedure so that he no longer removes the triangular area of mucosa described, but makes a primary incision as shown in Figure 2. He makes a vertical incision which begins at a point just below the clitoris and then goes around on both sides of the urethral orifice in the form of a circle, continuing below in a straight line to a point as low as is necessary in each particular case. Through this incision the two edges of the wound are undermined to an adequate point, after which the detachment of the urethra can be done with care, so that no tension is exerted on the border of the surrounding mucosal collar. The urethral orifice with its collar is reunited to the mucosa just below the clitoris (Figs. 3 and 4). After the urethra has been transplanted as much of the mucosa as necessary is removed (Figs. 5, 6, and 7). When a vaginal or uterine descensus (or a prolapsus) is present, associated with incontinence, the incision is prolonged in the usual manner to the cervix. The bladder which is exposed is elevated and the muscles of the urogenital diaphragm are sutured

together. The anatomical condition, before the supporting suturing is done, presents the appearance of a figure 8. In its entirety, the operation is so minor that it can be performed without difficulty in young as well as in old patients. After operation, a small rubber catheter is placed in the urethra for 2 or 3 days and then removed.

To illustrate the usefulness of the operation, the author reports in detail a case treated by the method described. The patient, a woman of 50 years of age, had already had two operations according to the method of Martius without satisfactory results, but very satisfactory results were obtained by the author's operation in this case. Although only 2 years have elapsed since the operation, the patient is well and in a very happy condition.

BLACKWELL MARKHAM, M.D.

Blanchard, O.: The Value of the Smears from the Vaginal Secretion in Establishing the Differential Diagnosis of the Ovarian Activity in Women (Valor del extendido vaginal para el diagnóstico de la actividad ovárica en la mujer). *Obst. gin. lat. amer., B. Afr.*, 1946, 4: 107.

The author has found previous studies corroborating his findings that the smears obtained from the vaginal secretion of women present changes which are related to the different phases of the menstrual period. He also found that it is possible that the

morphological aspect of the vaginal smears varies in different anomalies.

The administration of several hormonal preparations produces changes in the morphology of the smears and the authors believe that a dose for such therapeutic measures could be ascertained as the relation of the estrogens and androgens to the changes are quite definite and even characteristic. Irritation, infections, or individual variations can change the aspect of the morphological elements of the secretion from the vagina.

WILLIAM E. RICKETTS, M.D.

Douay, E.: Pelvic Endometriosis. (Endométriose pelvienne). *Rev. fr. gyn. obst.*, 1946, 41: 92.

Stimulated by papers and discussions of endometriosis given at the recent French Congress of Surgeons, the author reviews his experiences with this disease.

As to the pathogenesis of this disease, he leans to the migratory theory. According to this theory, uterine mucosal cells, especially at the time of menstruation, are capable of migrating from the uterus by way of the lymphatics, the blood vessels, and the reflux flow through the tubes to neighboring tissues and organs and into the peritoneal cavity. In certain cases the uterine mucosal cells, having migrated by one of these routes, fix themselves in their new habitat, and grow and develop into endometriomas. In these cases, the author believes, the displaced uterine cells are given a peculiar vitality and are made to develop into endometriomas under the influence of an abnormal activity of the ovary. CastRATION, which arrests the development and permits the regression of endometrial tissues, exerts its effect on these tumors not so much by causing a cessation of menstruation (thereby removing the source of uterine transplants) as by removing the abnormal activity of the ovary, which (in certain cases) permits migratory uterine cells to develop into endometriomas. The author hints that the prime cause of the abnormal activity of the ovary may be due to a function of the hypophysis.

Fourteen operative cases are reported in detail by the author. From his observation of these cases, he formulates his views as to the diagnosis and treatment of endometriomas.

Endometrial dysmenorrhea is the most characteristic clinical sign of pelvic endometriosis. It gains its maximum intensity at the end of menstruation and is prolonged several days later. The pain is located at the site of the endometrial lesion, but it radiates throughout the pelvis, to the rectum, to the ovaries, to the lumbosacral region, the buttocks, and the perineum. It is due to the distention of the small cavities lined with uterine mucosa which undergo, at menstruation, the same catamenial modifications that the mucosa of the uterus undergoes. The blood, on finding no outlet, distends the endometrial cavities and causes pain which is more acute as the tissue surrounding the endometrioma is more dense. Dysmenorrhea is at times violent and increases with each

menstrual period. In 8 of the 14 cases cited, this dysmenorrhea was present; it was associated with other causes of dysmenorrhea in 4 cases, and absent in 2 cases in which the tumor developed in pliable tissues more tolerant to distention.

This dysmenorrhea can be differentiated from (1) that resulting from mechanical causes, e.g., stenosis of the cervix and displacements of the uterus, as dysmenorrhea in the latter cases is present at the beginning of menstruation; (2) that resulting from uterine colic due to the expulsion of clots and shreds of uterine mucosa, which is present only during the period; (3) that resulting from ovarian disease which is usually premenstrual; and (4) that resulting from acute inflammation of the adnexa, which is usually postmenstrual.

Pelvic examination reveals the presence of conditions as cervical stenosis, uterine displacements, and adnexal disease.

Sterility, habitually observed in endometriosis (2 children in the 14 cases observed by the author) is not only due to tubular sterility but also to ovarian dysfunction.

Functional troubles of the ovary have repercussion in the general condition of the patient, giving rise to irritability, fatigue, and emaciation. These disappear after operation.

Vaginal examination in endometrioma of the posterior cul-de-sac reveals the presence of a hard retrocecal mass adherent to the vaginal wall and very sensitive to palpation.

Rectal examination reveals a tumor adherent to the rectum, while the overlying mucosa is pliable. No blood appears on the examining finger.

In endometrioma in the region of the ovary, examination reveals the presence of a fixed indurated mass painful on palpation. It can be differentiated from ectopic pregnancy in that the periods have continued regularly, unaltered in character and abundance. Acute inflammation of the adnexa is ruled out as endometrioma is unaccompanied by fever and genital inflammations. Tuberculosis of the adnexa is the most difficult lesion to differentiate, because hardness of the lesion and slow and progressive development without a great amount of fever may be present in both conditions.

In the region of the uterus, endometrioma resembles fibroma, but progressive development, inefficacy of medical treatment, and extreme sensitiveness on palpation favor endometrioma.

Failure to make a diagnosis at the time of operation is exceptional because (1) there is bloody liquid in the peritoneal cavity, often brownish and sticky; (2) the ovary, often polycystic, is adherent without signs of inflammation and the tubes are patent; (3) the detachment of adhesions of the ovary leads to the rupture of the bloody cysts; (4) there are resistant, fibrous cords with retraction and displacement of the mobile organs; (5) the endometrioma does not protrude above the surface of the peritoneum but forms an induration beneath it; and (6) there are little brown bodies, the size of a pinhead, in the peri-



teum, which are the little bloody cysts characteristic of endometrioma.

The following methods of treatment are listed: (1) hormonal treatment with testosterone, (2) castration by means of x-rays or radium, (3) surgical castration, and (4) complete excision of the lesions. If the lesions are limited, operation will be conservative, and the ovarian and genital function will be retained. If the lesions are extensive, the operation will be radical—hysterectomy with castration.

The method of treatment advised by the author is surgical intervention after a trial treatment with testosterone in moderate doses (from 80 to 100 mgm. monthly) over a relatively short period (3 months). If the painful crises persist and the tumor continues to grow, surgical intervention is indicated.

Operation allows verification of the diagnosis, evaluation of the situation and extent of the endometrial lesions, reveals the presence of associated lesions, and allows an opportunity to act accordingly.

One must be content to remove all that is easily removable. In general, total or subtotal hysterectomy with castration is performed if the woman is relatively old or near the time of the menopause. If the woman is young a fragment of healthy ovary, either *in situ* or as a graft in the labia majora, is necessary to prevent the discomforts of castration. An ovarian graft in the labia is more desirable for if it undergoes cystic degeneration or develops into an endometrioma, it can be removed easily under local anesthesia. If such conditions occur in the fragment of ovary left *in situ*, radiotherapy may be employed to suspend the abnormal ovarian activity. The vitality of the graft lasts from 6 months to 2 years. Hormonal therapy is used, if necessary, after the ovarian graft ceases to function.

Some of the extensions of the endometriomas are important from the surgical point of view.

As the fibrous bands of endometrial tissue increase in size, they displace the mobile organs, distort them, invade them, and disturb their function, e.g., invasion of the colon and the rectum. It is usually possible to remove the tumor without wounding the invaded organ.

The endometrial tumor has a tendency to encircle an organ, e.g., the ureter, deform it, and interfere with its function without invading its tissue. The tumor can often be removed without harming the ureter as its walls are usually intact.

At the time of operation, the surgeon should remove all endometrial lesions capable of producing subsequent trouble unless this would seriously interfere with the recovery of the patient.

BLACKWELL MARKHAM, M.D.

Mayo, S.: The High Peritonization in Gynecological Surgery (La peritonización alta en cirugía ginecológica). *Sem. med., B. Air.*, 1946, 53: 509.

The author has found that in Buenos Aires surgeons performing high peritonization or walling off of the pelvis in gynecologic surgery obtain very good results. The suprapubic drainage used formerly is used only very occasionally at the present time. The author advises such a procedure when gynecologic exeresis is done and especially in cases in which there is a cancer of the uterus. High peritonization was done in 42 cases: for neoplasia of the neck of the uterus in 24, for neoplasia of the body of the uterus in 4, for myoma with inflammation of the adnexa in 12, for myoma with endometriosis in 1 case, and for a calcified placenta in 1 case.

WILLIAM E. RICKETTS, M.D.

# OBSTETRICS

## PREGNANCY AND ITS COMPLICATIONS

Ziskin, D. E., and Nesse, G. J.: *Pregnancy Gingivitis: History, Classification, and Etiology*. *Am. J. Orthodont.*, 1946, 32: 390.

Gingivitis occurs in from 50 to 70 per cent of pregnant women as compared with 15 to 18 per cent of nonpregnant women. The authors in an extended study, of which this article is a correlative summary, present a classification of pregnancy gingivitis and offer a concept of its etiology.

The classification is based primarily on clinical observations made throughout pregnancy. Five major types of pregnancy gingivitis are distinguished clinically. They range from the commonest form characterized by bleeding from the gums to the so-called "pregnancy tumor." This classification represents the progressive changes in pregnancy, so more than one type may be present in the same case. The microscopic changes in biopsies from several hundred cases of pregnancy gingivitis are essentially the same. In the gingivae and oral mucous membranes during pregnancy there is a loss of surface keratin, hydropic alteration of the stratum spinosum, hyperplasia of the stratum germinativum, and inflammatory changes in the lamina propria.

In collecting evidence for the probable etiology of pregnancy gingivitis the authors have considered the general physiological changes in pregnancy, with special attention to the established interrelationships of endocrine and metabolic functions. This includes a consideration of the action of the hypophysis, the thyroid, the adrenal cortex, the ovaries, the placenta, and the vitamins. The changes that other glandular imbalances may produce in the gingivae have been noted, and in this connection the effects of hormonal administration on the gingivae of Rhesus monkeys are mentioned.

It appears that the immediate cause of the gingival changes is a diminished utilization of estrogen or a modification of estrogen metabolism. The following possibilities are set forth:

1. Estrogen during pregnancy is present in bound, inactive form, so that it may not be available to the gingivae to the expected extent, and hence does not have the usual beneficial effect on the gingivae.

2. There may be a reduced ability of the oral tissues to utilize the available estrogen because of the increased amounts and modifying effect of progesterone.

3. The large amounts of chorionic gonadotropin may affect the gingivae directly or indirectly.

4. The increased activity of the thyroid and the adrenal cortex may modify the effect of available estrogen on the gingivae.

5. Nutritional factors may alter the amount of endogenous estrogens available for the gingivae.

L. JAMES TALBOT, M.D.

Parviainen, S.: *The Frequency of Nephrogestosis during the Years of War* (*Fréquence de la néphrogestose pendant les années de guerre*). *Acta obst. gyn. scand.*, 1946, 26: 174.

The frequency of nephrogestosis markedly diminishes during the years of war. Restrictions of diet, necessitated by the emergency of war, are considered to be the cause of this diminution.

The frequency of nephrogestosis was studied by the author in 2 localities, Helsinki and Turku, for the period from 1935 to 1944. A total of 31,125 deliveries were studied. Of the patients, 16,965 were seen at the Gynecological Clinic of the University of Helsinki, 11,484 at von Heideken's Maternity Hospital at Turku, and 2,676 at the Departmental Hospital at Turku. The patients at von Heideken's Hospital were inhabitants of the city of Turku, while those at the Departmental Hospital were from rural areas.

Among the 16,965 deliveries at the University of Helsinki made in the period from 1935 to 1944, there were 2,106 cases of nephrogestosis (12.6 per cent), while at this same institution, for the period from 1926 to 1935, the percentage of nephrogestosis was 19.2.

Among the 11,484 deliveries made at von Heideken's Hospital in the period from 1935 to 1944, there were 2,246 cases of nephrogestosis (19.6 per cent), while for the period from 1926 to 1935 the percentage of nephrogestosis was 20.8.

Among the 2,676 deliveries at the Departmental Hospital at Turku in the period from 1935 to 1944, there were 453 cases of nephrogestosis (16.9%); no record was given for this condition from 1926 to 1935.

The frequency of nephrogestosis reached its maximum at Helsinki in 1936 with a percentage of 24.2, and its minimum in 1943 with a percentage of 5.6.

At Turku, the frequency of nephrogestosis reached its maximum in 1939 and its minimum in 1943.

Nephrogestosis is more general among primiparas than among multiparas. From 1935 to 1944 at Helsinki, nephrogestosis occurred in 15.9 per cent of the primiparas and in 8.8 per cent of the multiparas. At von Heideken's Hospital during the same period nephrogestosis occurred in 23.4 per cent of the primiparas and in 15.3 per cent of the multiparas; at the Departmental Hospital it occurred in 20.7 per cent of the primiparas and in 13 per cent of the multiparas. During the war years the disease diminished in frequency in both primiparas and multiparas.

The war affected the young women more than the older women as nephrogestosis occurred less often in the young mothers, but the more serious cases of nephrogestosis occurred in the older mothers.

The frequency of nephrogestosis diminished also among the cases of twin pregnancy during the war years.

The frequency of the less severe cases of nephrogestosis (albuminuria and nephropathy) markedly

diminished during the war years, but the more severe cases (pre-eclampsia and eclampsia) showed little diminution in frequency during the war.

While the total mortality during delivery decreased during the war years, the mortality among patients with nephrogestosis increased.

While the total infant mortality decreased during the war years, the infant mortality among the cases of nephrogestosis markedly increased during this period.

In summary, it was found that nephrogestosis of all grades appears to decrease during wartime, chiefly because of the impaired nutrition. Yet the nerve strain of war tends to heighten the blood pressure and increase the liability to convulsions which contributes to the increase in number of the more severe cases of nephrogestosis.

BLACKWELL MARKHAM, M.D.

Duckering, F. A.: The Significance of Myoma Uteri in Pregnancy. *Am. J. Obst.*, 1946, 51: 819.

The incidence of myoma uteri among the obstetric patients at the Woman's Clinic of the New York Hospital is 1.4 per cent. The role of myoma uteri in causing complications of pregnancy is clarified by comparing the patients who had myomas over 6 cm. in diameter to patients with myomas that were less than 6 cm. in diameter.

Since myoma uteri are found more frequently in the late childbearing ages, there is a high incidence of elderly primigravidae (15.7 per cent). The significance of myomas in causing sterility is difficult to evaluate.

Myomas are more easily detected early in pregnancy or the postpartum period when the entire surface of the uterus can be explored on bimanual examination. Frequently they are only discovered when complications of pregnancy and delivery focus attention on them. Antepartum pain due to myoma was present in 11 per cent of the patients in this series. However, there were very few cases in which pain was severe enough to necessitate operative intervention. The incidence of abortion (17.1 per cent) and of premature labor (5 per cent) in this series was twice the clinic incidence, which is 8 per cent and 2.5 per cent, respectively.

Presentation is affected only by large tumors which interfere with the adaptation of the fetus to the longitudinal axis of the uterus. There is no evidence that myoma uteri is a factor in causing prolonged labor or premature rupture of the membranes.

There is a high operative incidence among patients with large myomas (47 per cent) when compared to patients with small fibroids (23.4 per cent) who have an incidence of operative deliveries similar to the general clinic.

Thirteen patients had definite dystocia due to myoma. Postpartum hemorrhage is rarely caused by myomas. The incidence of postpartum hemorrhage among the patients was 3.8 per cent, an incidence similar to that found in the total clinic, which varied from 1.7 per cent to 4.4 per cent during

the same period of time. The incidence of puerperal sepsis was 15.8 per cent, or more than twice as high as is found among the general clinic population. The increase in morbidity occurs almost entirely in the group of patients with large myomas. However, it cannot be accounted for on the basis of an increased operative incidence in this group as it is also proportionately higher following abortion and spontaneous delivery. The fetal mortality among patients in this series is 9.6 per cent compared to that of the clinic, which is 3.46 per cent. There were 3 maternal deaths. The presence of myomas was incidental and entirely unrelated to the cause of death in 2 of the patients. EDWARD L. CORNELL, M.D.

Dannreuther, W. T.: Therapeutic Abortion in a General Hospital. *Am. J. Obst.*, 1946, 51: 54.

The author originally compiled the statistical data to secure the figures indicating the frequency of therapeutic abortion during a 10 year period. In this group of 84 cases, many of the abortions were done before the adoption of the existing rules at the New York Postgraduate Hospital. Possibly some of them would have been refused to-day.

It would seem an almost impossible task to prove exactly to what extent a therapeutic abortion contributes to the prolongation of life expectancy. The author has no intention of implying that a therapeutic abortion can cure epilepsy or a brain tumor or any other disease, but he believes that it may protect the health and lengthen the life of many patients whose existence might otherwise be much more distressing.

EDWARD L. CORNELL, M.D.

## LABOR AND ITS COMPLICATIONS

Farber, E. P.: The Induction of Labor with Methergine. *Am. J. Obst.*, 1946, 51: 859.

It is not the purpose of this article to advocate the routine induction of labor; rather it is to set forth a method of inducing labor which will be relatively safe to both the mother and infant which may be used when the induction of labor is indicated.

A new synthetic ergot preparation, methergine, was employed for the induction of labor in 30 consecutive cases and satisfactory results were obtained in 27 instances. Methergine was shown to have the ability to induce labor in the presence of intact as well as ruptured membranes. There were no maternal or fetal complications, and the length of labor was materially shortened when methergine was used. Methergine may have considerable value in cases of uterine inertia.

EDWARD L. CORNELL, M.D.

Ullery, J. C.: Continuous Spinal Analgesia in Cesarean Section. *Am. J. Obst.*, 1946, 51: 100.

From the experience of delivering 300 patients by cesarean section under continuous spinal analgesia with no maternal deaths, the authors believe that this is a safe anesthetic procedure for both mother and child. All of the babies, excepting the stillborn,

showed no anoxemia, cried at once, were of good color, and required no resuscitation. The postoperative morbidity of the mothers was low, and the complications were no greater than those with inhalation anesthesia. The advantages of continuous spinal analgesia with its safety, low dosage, and controllability are emphasized and should make its use desirable in cesarean section. The technique is easy and requires only the care and caution that should be given when administering any anesthetic.

EDWARD L. CORNELL, M.D.

### NEWBORN

Russ, J. D., and Strong, R. A.: Asphyxia of the Newborn Infant. *Am. J. Obst.*, 1946, 31: 643.

This study is based on 1,144 resuscitations of the newborn. In general, primiparas produce more asphyxiated babies than do multiparas. However, in the multiparous mother, for some undetermined reason, the third, sixth, eighth, and eleventh babies seem to have a greater tendency toward asphyxiation than the others.

It is becoming increasingly evident that the prolongation of labor is by far the most outstanding single cause of asphyxia of the newborn. It has been too easy to blame the analgesic drugs, but the asphyxia which is produced by drugs is by no means either as frequent or as severe as that produced by a prolonged labor.

It is the authors' very firm and definite conviction that, if a routine catheterization of the newborn be done at every cesarean section immediately upon delivery, the death rate can be reduced from an

TYPE OF DELIVERY	ASPHYXIA RATE - %	DEATH RATE - %
Version and extraction	80-90	25-35
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Low forceps	15-25	3-5
Spontaneous delivery	10-20	2-3
Low forceps with episiotomy	10-20	1-3

average between 8 and 10 per cent to as low as 2 per cent.

Anoxemia from many causes is responsible for 18.5 per cent of all deaths in newborn babies. It is the fourth most frequent cause of death in this age group. Among the most frequent contributing factors of anoxemia are the age and parity of the mother, duration of labor, type of delivery, prepartal analgesia, and the anesthetics used during delivery. Less frequently, prematurity, premature separation of the placenta, bleeding placenta previa, or a short cord, prolapse, torsion, knot, kink, or compression of the cord may cause it. Anoxemia prolonged more than 2 minutes after delivery will cause cerebral changes, but the prompt initiation and maintenance of respiration within 30 seconds after the cord is cut will prevent these changes, and if respiration is established before 2 minutes it may oxygenate the blood sufficiently to arrest any changes which have begun.

EDWARD L. CORNELL, M.D.

diminished during the war years, but the more severe cases (pre-eclampsia and eclampsia) showed little diminution in frequency during the war.

While the total mortality during delivery decreased during the war years, the mortality among patients with nephrogestosis increased.

While the total infant mortality decreased during the war years, the infant mortality among the cases of nephrogestosis markedly increased during this period.

In summary, it was found that nephrogestosis of all grades appears to decrease during wartime, chiefly because of the impaired nutrition. Yet the nerve strain of war tends to heighten the blood pressure and increase the liability to convulsions which contributes to the increase in number of the more severe cases of nephrogestosis.

BLACKWELL MARKHAM, M.D.

Duckering, F. A.: The Significance of Myoma Uteri in Pregnancy. *Am. J. Obst.*, 1946, 51: 819.

The incidence of myoma uteri among the obstetric patients at the Woman's Clinic of the New York Hospital is 1.4 per cent. The role of myoma uteri in causing complications of pregnancy is clarified by comparing the patients who had myomas over 6 cm. in diameter to patients with myomas that were less than 6 cm. in diameter.

Since myoma uteri are found more frequently in the late childbearing ages, there is a high incidence of elderly primigravidae (15.7 per cent). The significance of myomas in causing sterility is difficult to evaluate.

Myomas are more easily detected early in pregnancy or the postpartum period when the entire surface of the uterus can be explored on bimanual examination. Frequently they are only discovered when complications of pregnancy and delivery focus attention on them. Antepartum pain due to myoma was present in 11 per cent of the patients in this series. However, there were very few cases in which pain was severe enough to necessitate operative intervention. The incidence of abortion (17.1 per cent) and of premature labor (5 per cent) in this series was twice the clinic incidence, which is 8 per cent and 2.5 per cent, respectively.

Presentation is affected only by large tumors which interfere with the adaptation of the fetus to the longitudinal axis of the uterus. There is no evidence that myoma uteri is a factor in causing prolonged labor or premature rupture of the membranes.

There is a high operative incidence among patients with large myomas (47 per cent) when compared to patients with small fibroids (23.4 per cent) who have an incidence of operative deliveries similar to the general clinic.

Thirteen patients had definite dystocia due to myoma. Postpartum hemorrhage is rarely caused by myomas. The incidence of postpartum hemorrhage among the patients was 3.8 per cent, an incidence similar to that found in the total clinic, which varied from 1.7 per cent to 4.4 per cent during

the same period of time. The incidence of puerperal sepsis was 15.8 per cent, or more than twice as high as is found among the general clinic population. The increase in morbidity occurs almost entirely in the group of patients with large myomas. However, it cannot be accounted for on the basis of an increased operative incidence in this group as it is also proportionately higher following abortion and spontaneous delivery. The fetal mortality among patients in this series is 9.6 per cent compared to that of the clinic, which is 3.46 per cent. There were 3 maternal deaths. The presence of myomas was incidental and entirely unrelated to the cause of death in 2 of the patients. EDWARD L. CORNELL, M.D.

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EDWARD L. CORNELL, M.D.

# GENITOURINARY SURGERY

## ADRENAL, KIDNEY, AND URETER

Farneti, F.: Tuberculosis of the Renal Pyramids (Contributo allo studio della tubercolosi delle papille renali). *Arch. ital. urol.*, 1945, 21: 201.

Tuberculosis of the renal pyramids may be subdivided into the following classes: (1) miliary diffuse, (2) miliary circumscribed, (3) nodular, (4) cystic, and (5) ulcerocaseous.

The spread of the tubercle bacillus to the kidney may be hematogenous, through ascending urogenital infection, by way of the lymphatics, or by a combination of these methods. Hematogenous spread may be direct, as the apex of the pyramids is a vascular net which forms a delicate reticulum of capillaries stopping the tubercle bacilli at this point, or it may be indirect, the bacilli passing through the glomerulus with the urine and thus infecting the pyramids.

A typical case presents the following symptoms: pyuria, hematuria, dysuria, nocturnal polyuria, spontaneous attacks of pain in the lumbar region, and lumbar tenderness.

Recovery of the tubercle bacilli by ureteral catheterization makes an absolute diagnosis although the history of tuberculosis elsewhere in the body is of some help, and in some cases an exploratory kidney operation is necessary to reveal the tuberculosis on sect on.

Early nephrectomy is the treatment of choice provided the other kidney has good function. Prolonging the treatment causes the lesion to become diffuse and spread to the opposite kidney.

ARTHUR F. CIPOLLA, M.D.

Deming, C. L.: The Prognosis and Problems in Renal Tumors. *J. Urol.*, Balt., 1946, 55: 571.

During the past 23 years, 82 cases of renal neoplasm have been admitted to the New Haven Hospital in New Haven, Connecticut. In the present report, these cases are carefully analyzed, and the methods of therapy evaluated.

Renal new growths were found to occur during two periods of life, the first decade and the latter decades. In the author's series 13.4 per cent of the tumors were found in children and this, along with the embryonic tumors in adult life, would seem to suggest a congenital factor. The absence of these tumors during adolescence, their scarcity during the third and fourth decades, and their preponderance in the male all are observations, but unexplained.

The cytological classification of tumors is referred to, but is viewed from the aspect of the clinician, and it is noted that irrespective of the histological picture, their subjective and objective findings are similar, as well as their prognosis. Present day therapeutics affords less than a 20 per cent chance of cure, and in this series only 9.08 per cent.

It is of interest to note in this series of cases that 11 occurred in children and only 3 of these were Wilms' tumors. The remaining tumors in this decade were sympathicoblastomas, sarcomas, embryonal carcinomas and neurogenic fibrosarcomas.

The author advocates repeated roentgenographic examinations to facilitate the diagnosis in questionable cases, but points out that usually pyelography quickly establishes the diagnosis of renal tumor by depicting a mass associated with the kidney, an abnormality or deformity of one or more of the calyces, or an abnormal peripheral outline of the suspected kidney. The author emphasizes the difficulty of surgical extirpation of a fixed kidney with tumor and suggests that the mobility of the organ be determined at the time of pyelography.

In this series of 82 patients with renal tumor, 69 had a nephrectomy, 4 had a biopsy of the tumor with ligation of the ureter, and 2 others had only a biopsy of the tumor. There were 4 operative deaths. Seven of the 82 individuals were admitted in extremis and died soon thereafter.

The mortality in the series of patients is presented graphically and reveals the results at a glance. In the group with hypernephromas, only 19.5 per cent of the patients were alive after 5 years; 14.6 per cent were alive after 10 years, but of these, only 9.08 per cent were free of tumor. The patients with sympathicoblastomas and embryonal carcinomas all died within 3 years. Tumors of the renal pelvis too were found problematical, and thus the author's final percentage of control was found to be 9.08 per cent for the group.

The unpredictability and multiplicity of metastatic lesions of renal new growths do not permit early removal of these lesions, and thus, control. Furthermore, irradiation has not proved to be effective since there is no means of absolute prediction of radiosensitivity. Thus, the only means of absolute cure is early diagnosis and complete surgical removal, but there is no means available to ascertain the presence or absence of minute widespread dissemination.

In addition it was found in this series of cases that there was little difference in the mortality of individuals whose condition was diagnosed and treated early, and in those in whom there was delay in diagnosis; i.e., 64 per cent and 58.7 per cent, respectively.

It is concluded from the finding of patients who died of the disease as late as 10 years following surgery, that a 10 year observation is not sufficient to assume a cure from renal malignancy, and that the present therapeutics which effects but a 9.08 per cent cure is far from satisfactory. The determination of malignancy and radiosensitivity by biological methods, in addition to the study of cytological architecture, is advocated along with the obvious fact

that the successful treatment of renal neoplasm is not found in the present methods at our disposal.

ROBERT LICH, JR., M.D.

**Jacobs, A.: Transplantation of Duplicated Ureters into the Bowel, with a Report on 3 Cases.** *Brit. J. Urol.*, 1946, 18: 4.

A double ureter is comparatively common, and the possibility of the existence of such an anomaly must be borne in mind whenever the operation of transplanting the ureters into the bowel is contemplated. Among a series of 44 patients, on whom the author performed this operation, a complete double ureter was found in 3, all on the left side.

In 1 case of urethrovesicovaginal fistula the 3 ureters were transplanted simultaneously. In the second case (papillary carcinoma of the urinary bladder) the right ureter was transplanted at the first stage, and at the second stage, a month later, both left ureters were transplanted and total cystectomy with removal of the prostate and seminal vesicles was carried out. In the third case (infiltrating carcinoma of the urinary bladder) 2 dilated left ureters were implanted, and at the second stage, 1 month later, the right ureter was implanted and total cystectomy was performed.

In spite of the dilatation of the left ureters in the last case the implant took well and urine promptly appeared in the rectum, as determined by drainage from a rectal tube. The quick immediate recovery was soon followed by rapid deterioration and death due to generalized metastases.

The technique employed in all 3 cases was essentially that of the Coffey No. 1 operation. The author recommends the temporary presence of a ureteral catheter while the serosal and muscular flaps are being approximated to prevent constriction. The catheter is then withdrawn before the distal end of the ureteral stump is inserted into the lumen of the bowel.

FREDERICK R. LIEBERTHAL, M.D.

## BLADDER, URETHRA, AND PENIS

**Michels, L. M.: Wounds of the Urinary Bladder.** *Ann. Surg.*, 1946, 123: 999.

In a 16 month period an auxiliary surgical group functioning in the Italian, French, and German theaters of war operated upon 3,154 wounded individuals; 155 of these (4.9 per cent) had bladder lesions. The diagnosis of a bladder lesion may be made from the alignment of the wounds of entrance and exit and by the location of the foreign body as demonstrated roentgenographically. The most frequent wounds of entry were in the buttocks (56 times) and in the anterior abdominal wall (56 times). Other sites of entry were in the hip, thigh, perineum, back, and flank. Wounds of exit were present in one-third of the cases, the missile having been retained in two-thirds.

There is nothing characteristic in the abdominal physical findings. The presence of a urinary fistula indicates damage to some portion of the genito-

urinary tract, as does hematuria. Clear urine does not contraindicate bladder damage (5 cases in this series). Filling of the urinary bladder with some solution prior to surgery for diagnosis is not recommended because of the danger of forcing contaminated material into the peritoneal cavity or retroperitoneal region. Since celiotomy is usually necessary for associated abdominal lesions, intraparietal bladder lesions can be seen directly.

The correct diagnosis was made preoperatively or at surgery in 149 of these cases. Six cases were overlooked, and 2 of the patients died. In 3 urinary fistulas developed, which later responded satisfactorily to cystostomy. The sixth patient passed a foreign body per urethra and recovered following the insertion of an indwelling catheter. Eighty-six per cent of the patients had bowel lesions in addition to the bladder damage. The former always receive primary consideration.

The mortality rate of patients having bladder lesions depends mainly upon how much bowel damage coexists. Uncomplicated bladder lacerations which are operated upon promptly are not life-threatening.

In 35 cases the injury was due to a bullet from a gun (mortality 34 per cent), in 71 to shell fragments (mortality 32 per cent), and in 9 to pressure (no mortality); in 46 cases the missile was not recorded.

In 137 cases the laceration was intraperitoneal, in 9 extraperitoneal, and in 9, both. Nine patients had a severe contusion without a laceration.

Repair of the laceration with suprapubic cystostomy is the surgical procedure of choice. The abdomen is opened to explore and repair whatever other intraperitoneal injury is present and the bladder injury is inspected and repaired at the same time.

No infection of the paravesical tissue occurred in any of the surviving patients.

FREDERICK R. LIEBERTHAL, M.D.

**Milner, W. A.: The Treatment of Carcinoma of the Bladder for the Past 5 Years, with Special Reference to the Closed Method of Treatment.** *J. Urol.*, Balt., 1946, 55: 607.

There are reported 245 cases which were operated upon for a vesical neoplasm during a 5 year period at the Albany Hospital in Albany, New York. The average age of the patients was 62.9 years, and the incidence in the male was found to be almost 3 times that in the female. The author notes with interest that 12.5 months elapsed after the initial symptom before the patient sought either diagnosis or treatment. Intermittent hematuria was the presenting symptom in 94 per cent of the individuals, and the remaining patients complained of dysuria or presented the neoplasm as an incidental finding during a cystoscopic examination undertaken for other reasons. In some the cystogram during intravenous pyelography presented the diagnostic filling defect of the bladder.

In 229 instances, or 93 per cent of the individuals, the closed method, or transurethral resection, was undertaken and the resection was carried to a depth



to expose the vesical musculature whenever neoplastic infiltration did not preclude this objective. In addition, it was advised that  $\frac{3}{4}$  of an inch of normal mucosa around the base of the tumor be removed and that this be followed by thorough fulguration of the base. The author emphasizes the fact that tumor size is not a determining factor in the use of transurethral resection in the treatment, and to substantiate this contention 3 cases are reported in which the resected tumor weighed more than 100 gm. One tumor, weighing 344 gm., was removed in two sittings; the second, weighing 132 gm., was resected in a single sitting; and the third, weighing 127 gm., was removed in 2 operations, like the first. The first of these 3 patients was relieved of his obstruction for 12 months following the surgery, and the 2 others are living and free of their disease for 3 years and 7 months, respectively.

In addition to resection and fulguration, the use of radon seeds and deep x-rays is advocated. Platinum nonremovable seeds of 1.5 mc. are implanted so that each seed radiates an area of 1 sq. cm. The selection of cases for radium implantation is based on the evidence of infiltration at the initial cystoscopy. The x-rays, of from 4,000 to 5,000 units, are delivered through 3 portals and are used in individuals in whom extension of the condition is believed to require additional therapeutic assistance. Also, the author believes that x-rays materially reduce the rate of recurrence in multiple papillary carcinoma of grade I.

Fifteen patients were treated with partial cystectomy or segmental resection of the bladder. One of the patients in this group was operated upon on 2 occasions and at the time of this report had survived for 4 years and showed metastatic lesions. Another died as a result of the surgery. Four patients died of their disease, and the remaining 9 were alive and well from 2 months to 5 years after operation. Five of the 9 patients mentioned have had small recurrences which were controlled by transurethral fulguration or resection.

In 3 instances total cystectomy was done and the patients lived from 12 months to 2 years. The indication for this procedure was intractable pain in 1 case and multiple papillary tumors in 2 cases.

In reviewing the pathology of the tumors removed it was found that of the 240 tumors graded the majority were papillary carcinomas of grades I and II and next in frequency were epidermoids of grades III, II, and IV, respectively.

It is noted that the mortality figures revealed that the majority of the patients died less than 2 years after surgery, and that of the entire group of 189 patients, 77 died. Ten individuals died of other causes and were free of tumor at the time of death; 2 were moribund and died without having an operation, and 59, or 32.2 per cent, died as a result of their disease. The operative mortality in total cystectomy was 33.3 per cent as compared to 6.6 per cent in segmental resection and 0.44 per cent in transurethral resection.

Of the living individuals the majority have survived operation less than 2 years, and 4 for 5 years. One of the latter is at present suffering with the disease; this individual had been treated by segmental resection of the bladder.

The author concludes that transurethral resection of bladder tumors is to be reserved for vesical neoplasms of the less invasive type, but should be executed with a distinctly radical approach. In instances of increased neoplastic invasion the more frequent use of segmental resection and complete cystectomy is to be seriously considered.

ROBERT LICH, JR., M.D.

Vajano, D.: The Treatment of Cancer of the Penis (Il trattamento del cancro del pene). *Tumori*, Milano, 1942, 28: 55.

Of all the tumors of epithelial origin, carcinoma of the penis is the rarest, being present in only 20 of 2,194 cases. Although most of the patients were in the 6th decade, the youngest one was 26 years of age, and the oldest was 82 years of age. Predisposing factors in order of frequency are: (1) phimosis, (2) balanitis, (3) syphilis, (4) chancroid, (5) leukoplakia, (6) hyperplasia, (7) Paget's disease, (8) Bowen's disease, (9) trauma, and (10) venereal warts.

The pathological findings are grossly classified into two forms: a papillary tumor of the glans or an infiltrative tumor of the prepuce, and, histologically, a spinocellular epithelioma or a basal cell carcinoma.

The symptoms are pain in the glans and purulent discharge from the urethral orifice, which may be mixed with blood.

Metastases are rare and, if present, are slowly carried through the lymphatics to the inguinal lymph nodes.

The treatment may be one of three types: (1) surgery, (2) radiation, and (3) a combination of surgery and radiation.

Surgical management may be as follows: (a) excision of the primary lesion with the electrocautery, which is indicated early when no lymphadenopathy is present; (b) partial amputation of the shaft of the penis with the electrocautery, which is indicated in carcinoma of the glans; (c) amputation of the entire shaft (Gould's operation), indicated in disseminated carcinoma of the corpus cavernosum and spongiosum; (d) total emasculation (Chalot's operation), reserved in cases in which the scrotum is invaded, and (e) extirpation of the inguinal glands in conjunction with the operation of Gould or Chalot, indicated in cases that have been subjected to previous surgery or radiation therapy.

In radiation therapy, radium is used on the initial lesion, while in the more advanced cases x-rays are used on the lesion and the inguinal lymph glands.

The mixed method of treatment may be as follows: (a) amputation and irradiation of the glands with x-rays or radium; (b) radium or x-ray treatment of the primary lesion and removal of the inguinal glands; (c) radium or x-ray treatment of the primary lesion and removal of the inguinal glands, followed

by postoperative radiation to the glandular area; (d) radiation of the primary lesion plus conservative amputation and radiation of the lymph glands, with or without extirpation; (e) circumcision and radiation of the primary lesion with radium, and (f) electroexcision of the primary lesion followed by radium therapy.

ARTHUR F. CIPOLLA, M.D.

### GENITAL ORGANS

Wattenberg, C. A.: Liver Changes and Other Effects of Diethylstilbestrol during Treatment of Prostate Gland Cancer. *J. Urol.*, Balt., 1946, 55: 631.

The toxicology of synthetic estrogens with reference to experimental animals is briefly discussed and a case is reported of an individual who developed hepatitis during diethylstilbestrol therapy for malignancy of the prostate.

The patient was white, and 63 years of age. There was present irregularity of the prostate suggesting carcinoma, but no evidence of metastasis. The patient was placed on 15 mgm. of diethylstilbestrol daily until 150 mgm. had been taken, and thereafter the dose was reduced to 10 mgm. a day for a period of several months until a total dosage of 1,940 mgm. were consumed. At this time there was no ankle edema, very little breast enlargement, and no tenderness or pain. In addition, the patient's initial nocturia of 6 times, frequency, inability or difficulty in initiating the urinary stream, and dribbling all had subsided. He felt himself in excellent health. The daily dose of diethylstilbestrol was reduced to 5 mgm. and after more than 620 mgm. had been used at this dosage, or a total of 2,700 mgm., the patient began complaining of gastric distress and a constant feeling of hunger in spite of eating regularly. This was followed by a dermatitis which was diagnosed as a "drug rash." Icterus soon followed and along with it, leg and ankle edema, enlargement and tenderness of the liver, and a prominence of the superficial abdominal veins. The icterus index was 200 and better x-ray examination of the bony pelvis revealed metastases although the prostate at this time felt small and soft.

At the time of an exploratory laparotomy the liver was found smooth and without tumor. A biopsy showed fibrosis of the portal areas, and surrounding the central veins the bile capillaries were dilated. There was evidence of bile retention and cloudy swelling—a toxic hepatitis. The gall bladder and common duct were dilated but this was found upon histological study to be due to edema, and a similar picture was found in the pancreas and a regional lymph node.

After several months of not taking diethylstilbestrol, the patient noticed the onset of urinary complaints. Since the resumption of the synthetic hormone was thought contraindicated in this case, a bilateral orchiectomy was done.

The author briefly mentions the side effects of diethylstilbestrol when it is given for carcinoma of the

prostate. The cytological effects in the prostatic cancer are regression of the previously foamlake cytoplasm, eccentricity of the nuclei, along with pyknosis, and even actual destruction leaving only cytoplasmic debris. In the testicle the effects are a thickening of the basement membrane of the seminiferous tubules with fibrous tissue and marked arrestment of spermatogenesis. The posterior urethra reveals squamous metaplasia. The breasts reveal edema, proliferation of the duct epithelium along with budding of the ducts, an increase in both connective tissue, and vascularity and a deposition of fat.

The article is well illustrated with exceptionally clear cut microphotographs of tissues in both the pre- and postdiethylstilbestrol phase.

ROBERT LICH, JR., M.D.

Sworn, B. R., Marshall, F. W., and Edwards, J. L.: Solid Tumors of the Epididymis. *Brit. J. Surg.*, 1946, 33: 375.

Tumors of the epididymis are still regarded as rare. However, in 5 years the authors have seen 3 such tumors of glandular type, 2 of which are described in detail. Each had a fibrous capsule containing smooth muscle in varying amount in addition to the glandular elements. Lymph follicles with germinal centers were also present. The morphology of the cells lining the tubules provided inconclusive evidence as to whether the growth was an endothelioma (or mesothelioma as suggested by Mackay) on the one hand, or an adenoma on the other.

Since glandular elements, plain muscle, and lymphoid tissue with germinal centers are associated in many of these tumors, and since their origin is still debated, the authors believe that the least objectionable and most noncommittal designation would be "mixed tumors" of the epididymis. As in the case of the salivary glands, the term is held not to possess the implications of teratoma.

These tumors appear to be benign and the history often covers many years, but the postoperative period is in most cases not yet long enough to be significant.

FREDERICK R. LIEBERTHAL, M.D.

Scheetz, R. J., and Leddy, E. T.: Roentgen Therapy for Malignant Teratoma of the Testis. *Am. J. Roentg.*, 1946, 55: 754.

This article is based on 54 cases of malignant teratoma of the testis that have been observed at the Mayo Clinic.

Since these tumors usually develop during the period of greatest sexual potency, it has been thought that there possibly is some relation between sexual function and the development of the tumor. A history of trauma can be obtained in from 10 to 30 per cent of the cases of teratoma but it is doubtful whether trauma has any etiologic significance. It does, however, serve to call attention to a pre-existing malignant lesion.

It is generally accepted that cryptorchidism tends to favor the development of malignant tumors of the

testis. In all of the cases in this series, the involved testis was situated in the scrotum. In the series of 54 cases of teratoma, the youngest patient was 15 years of age and the oldest was 59 years. In more than half of the cases (54 per cent) the patients were in the third decade of life and in 50 cases (93 per cent) the patients were between 15 and 39 years of age.

Broders divided tumors of the seminal epithelium into three main groups: (1) teratomas, (2) adenocarcinomas of the seminoma type, and (3) adenocarcinomas of the testis. The teratomas were subdivided into two subgroups: the benign and the malignant.

In this series of 54 cases, the site of the tumor was in the right testis in 28 cases and in the left testis in 26 cases.

A painless swelling of the testis was the initial symptom in 68 per cent of the 54 cases.

The tumor may be very small and be buried in the substance of the testis; on the other hand, the involved testis may be as large as a fetal head. In 13 of the 37 cases in which the tumor had not been treated previously, the involved testis was the size of an orange when the patient was examined.

In 7 cases the initial symptoms were referable to the metastatic lesions. This would seem to indicate that malignant teratomas tend to metastasize early, often before the patient is aware that the testis is the seat of serious trouble.

A painful testis was the only symptom in 3 cases, in 5 other cases pain was associated with swelling of the testis. In 8 additional cases, the patients complained of a painful testis when they sought medical advice, therefore, testicular pain was a prominent symptom in 16 cases. Pain occurs more frequently in cases of malignant teratoma than it does in cases of seminoma.

Many other symptoms were present by the time the patients consulted a physician. One of the commonest symptoms was dragging pain in the groin on the involved side, and this often was accompanied by pain in the lower part of the back.

In 17 of the 37 cases in which the tumor had not been treated previously, there was clinical evidence of metastasis when the patients were examined. The site of the metastatic lesions in these cases was: the para-aortic lymph nodes in 13 cases, the supraclavicular lymph nodes in 7 cases, the peribronchial lymph nodes in 6 cases, the inguinal lymph nodes in 5 cases, and the bones in 1 case.

In 5 cases the breasts were enlarged and tender. This change is due to an actual proliferation of the mammary tissue which apparently is stimulated by gonadotropic substances in the primary tumor or in the metastatic lesions.

A hydrocele was present in 7 of the 37 cases. A varicocele was present in 2 cases.

A few of the diseases that may be confused with a tumor of the testis are tuberculous epididymitis, hydrocele, hernia, gumma of the testis, and hematocele. The finding of a firm, smooth or nodular scrotal

mass that is about the same shape as a normal testis and does not involve the epididymis should cause one to suspect that a tumor of the testis is present.

The value of the tests for gonadotropin is decidedly limited for the following reasons:

1. From the diagnostic standpoint, one cannot confidently predict the histopathological type of testicular tumor on the basis of either the quantitative or qualitative determination of gonadotropin in the urine.

2. From the prognostic viewpoint, one cannot exclude metastasis because an excessive amount of gonadotropin is not determined in the urine.

3. The test is too expensive and complex to be used elsewhere than in large institutions.

In cases of tumor of the testis observed at the Clinic treatment usually consists of simple orchiectomy followed by roentgen therapy. The treatment, of course, is modified to fit the needs of the patient.

Leddy and Desjardins, and Nash and Leddy have described the technique of roentgen therapy of tumors of the testis.

The proponents of preoperative roentgen therapy claim that operation may cause metastasis and that preoperative roentgen therapy may seal off the lymphatics and prevent metastasis. The opponents of preoperative roentgen therapy maintain that orchiectomy will not cause metastasis if the spermatic cord is clamped at the external inguinal ring, and that it will effect a cure if metastasis has not occurred before the operation is performed.

The most convincing argument in favor of preoperative roentgen therapy is that it apparently has a tendency to increase the percentage of patients who live for 5 years after operation.

That a gummatous or a tuberculous testis has on occasion been irradiated as a result of a mistaken diagnosis of tumor is within the realm of possibility. In cases in which there is no evidence of metastatic lesions and in which the amount of gonadotropic hormone in the urine is within normal limits, one might never be certain of the diagnosis after preoperative irradiation.

Within a short period after roentgen therapy first was used in cases of tumor of the testis, it became obvious to many observers that true malignant teratomas are much less susceptible to the action of roentgen rays than are seminomas.

In the analysis of the results of roentgen therapy, 18 of the 54 cases were excluded for various reasons. The remaining 36 cases were divided into three groups: group 1 included 17 cases in which treatment was begun before there was any evidence of metastasis; group 2 included 11 cases in which there was clinical evidence of metastasis when treatment was begun, and group 3 included 8 cases in which the patients had undergone orchiectomy before they came to the Clinic. In all of the cases in the last group, clinical evidence of metastasis was present when the patients were first observed at the clinic.

Group 1. In this group of cases the prognosis obviously should be considered favorable. Treatment

consisted of simple orchectomy and postoperative roentgen therapy. Only 8 of the patients in this group were alive 5 years after orchectomy was performed, but 1 patient died of meningitis after mastoidectomy which was performed 55 months after orchectomy. The average period of survival of the patients who died was 19 months.

Group 2. In this group, the results were very discouraging. Only 1 of the 11 patients in this group lived more than a year after orchectomy. This patient lived 16 months after the operation.

Group 3. In a few of the cases in this group, roentgen therapy had been employed before the patients came to the Clinic. Radium therapy had been employed in 2 cases. In some respects, this group is a composite of groups 1 and 2 as some of the patients undoubtedly had undergone orchectomy before clinical evidence of metastasis had become manifest. The average period of survival after orchectomy was 17 months.

JOHN A. LOEF, M.D.

### MISCELLANEOUS

Winsbury-White, H. P.: Some Observations on the Incidence of 665 Personal Cases of Urinary Lithiasis. *Brit. J. Urol.*, 1946, 18: 13.

The author calls attention to the fact that certain easily distinguishable factors have controlled the incidence of urinary lithiasis, as demonstrated by a study of the literature of the past century. Vesical calculus was much more common than renal calculus until the beginning of the present century. The correction of bladder neck obstructions in the adult and the improvement of the diet of children, especially of the working classes, with the greater use of milk with its vitamin A and readily absorbable calcium, have led to a sharp reduction in the incidence of vesical calculus. Renal calculus has definitely been on the increase, especially in Central Europe, where from 1924 to 1937 an obvious "stone wave" has occurred.

Renal calculi are more common in the male and tend to favor the left side. The male internal genital organs are more intimately related to the urinary tract and hence infective processes occurring in them and obstructions resulting from them would tend to encourage pathological processes in the kidney more in the male than in the female. The relative incidence of stone in the urinary tract increases in the male sex as compared with the female as we descend, as follows: only a slight predominance in the kidney, more than 2 to 1 in the ureter, and more than 6 to 1 in the bladder.

Residual urine in the bladder is far more common in the male, and, when present, may in itself be an adequate explanation even with regard to the upper urinary tract.

Lithiasis tends to be multiple in the urinary tract, especially if untreated. In 51 per cent of the author's cases of renal calculus, the stones in the kidney were multiple and in 14 per cent they were bilateral.

Prostatic calculi commonly have the same chemical composition as renal calculi, and they are often associated with calculi elsewhere in the urinary tract.

FREDERICK R. LIEBERTHAL, M.D.

Begg, R. C.: Some Uses for Free Muscle Grafts in Urology. *Brit. J. Urol.*, 1946, 18: 10.

The author recommends the use of free grafts taken from the oblique abdominal muscles, the recti, pyramidales, or elsewhere in various urological procedures.

Effective hemostasis is accomplished when such grafts are used in the repair of operative wounds of the kidney substance after nephrotomy and partial resection, and for the control of bleeding of extrapelvic vessels. Incisions in the ureter, pelvis, or bladder may be effectively sealed, and postoperative leakage is prevented. In vesicovaginal and rectourethral fistulas a pad of muscle will form an effective buttress between the suture lines.

FREDERICK R. LIEBERTHAL, M.D.

# SURGERY OF THE BONES, JOINTS, MUSCLES, TENDONS

## CONDITIONS OF THE BONES, JOINTS, MUSCLES, TENDONS, ETC.

Agerholm, M., and Trueta, J.: Acute Hematogenous Osteomyelitis Treated with Penicillin. *Lancet*, Lond., 1946, 1, 877.

Two well defined groups of cases of acute hematogenous osteomyelitis were distinguished: (1) those admitted before the bone was seriously damaged and pus had been formed, and (2) those admitted with an abscess already present.

The authors propose the following conception of the disease process as a useful working basis. At the earliest stage there is a small focus of infection in the bone, probably with a septicemia. If the organism is penicillin sensitive, penicillin given at this stage will control the septicemia and limit the focus to an area small enough for resolution to occur. The presence or absence of roentgenographic changes depends on the size of the affected area and its position. If, however, the penicillin is not given at the early stage, the local infection will spread. The infection next reaches the periosteum. This provides a resistant barrier to penetration but is readily stripped up from the bone, and the pus, which is under considerable tension, may spread subperiosteally along the length and circumference of the shaft, causing further interference with the blood supply. If penicillin is given at this stage the general infection may be overcome, but the pus both within and without the bone, unless drained, remains as a twofold danger.

The following general principles and routine of treatment were advocated: (1) hematogenous osteomyelitis is in part a systemic disease and therefore penicillin must be given systemically; (2) systemic administration of penicillin alone can cure the disease provided that (a) there is no abscess at the focus, is continued long enough; (3) systemic administration of penicillin cannot sterilize an abscess, therefore systemic infection may be controlled, but even after and lead to extensive destruction of the bone (surgical removal of preformed pus is essential in this disease as in other infections susceptible to penicillin); and (4) after the removal of pus, systemic administration of penicillin can prevent the further formation of pus, and therefore primary suture is safe. In view of the danger of secondary infection in bone, primary suture is a valuable protection.

The penicillin was given intramuscularly either by drip or by intermittent injection. Intramuscular drips have been used whenever possible. They are used for children by the nursing staff. The E.M.S. penicillin drip set is used; 100 c.c. of saline solution is used to dissolve the 24 hour dose, a maximum of

400,000 units a day. This occasionally caused local cellulitis, and three patients developed "penicillin" abscesses containing sterile pus; all subsided after one aspiration.

Thirty cases of acute osteomyelitis were treated with penicillin in 18 months. Blood culture was positive in 14 of these cases. Penicillin was used alone in 9 cases; 2 of these were early cases and would now be treated surgically. Seven of 30 cases (about 1 in 4) were suitable for penicillin treatment alone. Penicillin was combined with surgery in 21 cases. Primary suture was done in 14 cases and secondary suture in 5 cases; 2 cases were not sutured. All cases operated upon were suitable for primary suture, but this was not realized at first.

In this series there was no death, no joint involvement, and no secondary focus after admission. At the end of 18 months, 4 cases still presented a sinus, but 2 of these were nearly healed; 28 patients had normal function; 1 patient admitted with septic arthritis of the knee had a limited range of movement; 1 had a sinus which kept her in the hospital.

C. FRED GOERING, M.D.

Oleaga Alarcon, F.: First Results in the Treatment of Osteomyelitis with Penicillin (Primeros resultados en el tratamiento de la osteomielitis con penicilina). *Rev. ortop. traumat.*, B. Air., 1945, 15: 61.

The author reports the findings in 11 cases of non-tuberculous osteomyelitis in single bones treated with penicillin. He found that the acute osteomyelitis is evidently influenced favorably by the penicillin treatment. In general there was rapid disappearance of the symptoms, but persistence of the roentgenological findings. The bacteria were stabilized or killed, but the tissue inflammation continued its course. The penicillin was found to be preferable to sulfa drugs in these cases because of the lack of toxicity.

In cases with osteomyelitis rest and immobilization are indicated in addition to the chemotherapy. Chronic osteomyelitis with sequestra should be operated upon.

The author thinks that penicillin treatment should be used in compound fractures in order to prevent chronic inflammation of the bone.

WILLIAM E. RICKETTS, M.D.

Pollidori, A.: Roentgenological Appearance, Early and Late, of Congenital Proluxation of the Hip Treated with Abduction Splints (Aspetti radiografici precoci e a distanza della prolussione congenita dell'anca trattata con l'abduzione sul cuscino deviatricore). *Chir. org. movim.*, 1943, 29: 116.

Seven hundred and seventy-seven cases of dislocation of the hip were treated at the Istituto Rizzoli from 1921 to 1937, by early application of abduction splints. Of these, 478 were available for subsequent re-examination. According to the classification of

Putti, a grade of 9 or 10, corresponding to good or excellent, was given to the results in 93.9 per cent of the cases. In 21 instances, an osteochondritic process was found involving the epiphysis or the growth center. These cases were again examined and evaluated, the time interval since treatment varying from 2 to 13 years.

The cases fell into two groups: (1) those with osteochondritis of the epiphysis, and (2) those in which rarefaction was limited to the epiphyseal line. In the first group it was noted that, even when the dislocation was frankly unilateral, completely normal conditions were never found on the other side. This fact conformed to the impression that neonatal dysplasia of the hip is always bilateral, as is also dystrophy; but since these findings are not confirmed by roentgenological studies in individuals older than 12 years, on the average, it is assumed that in many cases dysplasia and dystrophy are slight and may clear up spontaneously. On the affected side, it was found that there was either marked hypoplasia or a notable delay in the appearance of the epiphyseal growth center, in all cases. Such osteochondritic changes appeared early in the period of treatment.

In the second group the inferior portion of the femoral neck, close to the growth cartilage, showed changes resulting in failure of growth of that part and the characteristic deformity of coxa vara. In several cases the changes were limited to the inferior pole of the epiphysis.

Having described the small group of failures resulting from the prompt use of abduction splints, the author discusses the nature and pathogenesis of morbid processes associated with congenital preluxation treated by any method. The possible factors of trauma from manipulation, osteochondritis, and osteoarthritis are discussed, the latter two being in turn influenced by constitutional, vascular, or humoral factors. The frequently associated absence of the round ligament is cited, and the hypothesis is proposed that vascular alterations or lability could well be superimposed upon congenital dystrophy and dysplasia to bring about the described deformity.

Survey of long term results indicated that cases which became worse with age were those with associated osteoarthritis, a situation almost never found in cases treated very early. It is suggested that the virtue of treatment by abduction splints depends less upon the avoidance of surgery than upon the early timing of its institution.

EDITH B. FARNSWORTH, M.D.

Pacini, D., and Rizzi, G.: A Contribution to the Anatomic Study of the Round Ligament of the Femur (Contributo allo studio anatomico del legamento rotondo del femore). *Chir. org. movim.*, 1943, 29: 196.

The present studies are based upon the gross and histological examinations of 150 round ligaments, of which 40 were taken from fetuses in various stages of intrauterine life. In addition, arteriograms were made in 6 cases by the injection of the iliac artery.

The following observations and conclusions were made:

1. The round ligament is found to act as a vector for blood vessels to the epiphysis of the femur from 4½ months of intrauterine life up to old age.

2. Arteries of injectable caliber never exceed 2 in number.

3. In the fetus and the infant these vessels supply only the region of the fovea, whereas in later life they are seen to participate in the circle of the circumflexes.

4. Throughout the years of growth and adulthood, the artery of the round ligament is found to enlarge and penetrate the spongy bone.

5. A mechanical function subserved by the round ligament is highly questionable.

On the basis of these observations which were made in addition to microscopic studies of the ligaments and vessels, it is to be concluded that the role of the round ligament in diseases of the hip joint has been overestimated, whereas in fractures of the neck of the femur it is probably of prime importance.

EDITH B. FARNSWORTH, M.D.

Bonnin, J. G.: Osteochondritis Dissecans and Torn Lateral Meniscus. *Brit. J. Surg.*, 1946, 33: 380.

The association of osteochondritis dissecans with lesions of the menisci was found in 3 cases by Fairbank. The author notes that osteochondritis dissecans usually occurs on curved surfaces which are subjected to frictional strain, such as the superior articular surface of the femur, the upper surface of the talus, and the capitellum of the humerus.

In the case presented, the patient had a bucket handle lesion of the lateral meniscus with a history of repeated locking extending over a period of 7 months. At operation there was found a curved fissure in the external condyle of the femur overlying the osteochondritic fragment which had been visualized in the roentgenogram. The lateral meniscus was found to have a bucket handle tear, which was turned over and lying in the intercondylar notch.

The semilunar cartilage was removed. Fifteen 1/16th inch drill holes were made through the depressed cartilaginous area into the condyle of the femur, and the joint was then closed. The limb was rested for a fortnight in bed and for 6 weeks thereafter in a plaster cast.

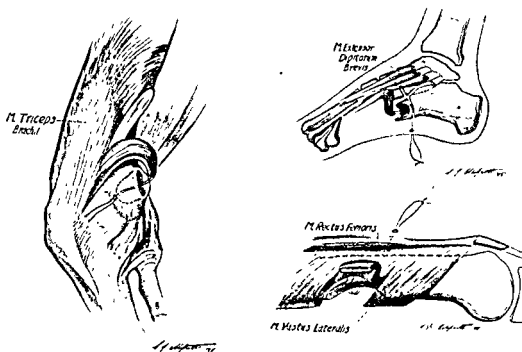
Ten weeks later, approximately 18 weeks after surgery, there was still a small effusion, but the patient had no complaints and could walk 4 miles.

DANIEL H. LEVINTHAL, M.D.

## SURGERY OF THE BONES, JOINTS, MUSCLES, TENDONS, ETC.

Prigge, E. K.: The Treatment of Chronic Osteomyelitis by the Use of Muscle Transplant or Iliac Graft. *J. Bone Surg.*, 1946, 28: 576.

The author presents the method used in treating 64 separate foci of chronic osteomyelitis in 61 patients on the orthopedic service of the De Witt



Figs. 1, 2 and 3. Examples of muscle pedicles used in filling bone defects.

General Hospital, Auburn, California. Practically all areas of the skeleton were involved. Healing occurred in a high percentage of the cases within 10 weeks and there were no recurrences, pathological fractures, or fatalities. The average period of observation was 7½ months.

It has become apparent that penicillin, like the sulfonamides, given either systemically or locally, is not entirely effective in tissues with little or no vascularity. Such tissues include sinus tracts with surrounding cuff of dense scar tissue, bone abscesses, sequestra, and the area of eburnated bone which is frequently found at sites of chronic osteomyelitis.

It was known that in osteomyelitis of a rib or of the fibula, excision of that part of the bone containing the infection is almost invariably followed by prompt and complete healing, because of the fact that upon removal of the diseased bone the adjacent viable and vascular (and, therefore, infection resistant) muscles fold into the defect, obliterating the dead space. Therefore, it was believed advisable to treat bone infection wherever found in a similar way, that is, by excising all infected and hypovascular tissues, obliterating the dead space, and closing the wound.

Recently the obliteration of bone defects by exteriorization and the application of primary or early secondary skin grafts directly to the defects has again been recommended and good results are reported.

Two methods of obliterating the defects are described. The first is by the use of the viable muscle

pedicle as suggested by Starr and Mercer, and the second by the use of thin chips of cancellous bone obtained from the wing of the ilium.

The use of the muscle pedicle is the method of choice and can be used in such skeletal areas as the scapula, clavicle, humerus, forearm bones (except the radial styloid), and metacarpals in the upper extremity; the pelvis, femur, fibula, and metacarpals (and in selected instances the tibia) in the lower extremity; and the vertebral processes and ribs. In these areas the procedure was to excise the avascular and infected tissue radically, fill the bone defect with viable muscle, and do a loose primary or secondary suture even if this meant leaving the extremity flail, but clean surgically. Closure of the skin and superficial fascia over the wound should be done, even if it is necessary for the operator to make a relaxing incision on one or both sides of the original wound.

Methylene blue injected into the sinus tracts aids en bloc excision. The surgical approach always extends well into normal tissue, both proximal and distal to the diseased condition. This is essential, not only for complete visualization of the diseased tissue but for preservation of important nerves and vessels and for a proper selection of a portion of muscle to be sacrificed, if needed, by forming it into a pedicle which must be viable. All abnormal tissue—sinus tracts and infected granulation tissue, sequestra, eburnated and abnormal bone—and foreign bodies, if involved, were removed radically so that all remaining tissue appeared normal and had good vas-

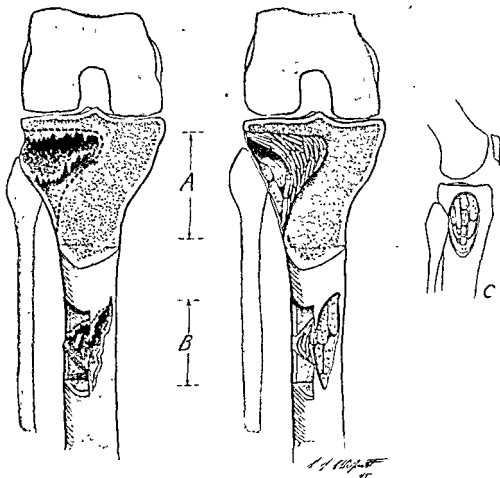


Fig. 4. Shows two typical defects, before and after excision and iliac bone graft. A, Coronal section of a large defect and detail of "bricking-in" the iliac chips. B, Shows partial coronal section. C, Sketch of lateral view, showing the surface of the grafted area.

cularity. The bone defect, if shallow, was obliterated by slight displacement of the surrounding muscles; if deep, a muscle pedicle was formed and sutured into the defect. A direct or eccentrically placed drain was removed in 48 hours. Appropriate plaster cast immobilization was applied, as indicated. All of the patients received penicillin intramuscularly for 3 weeks.

Forty-four foci of infection in 42 patients were treated by this method. Good results were obtained in 43; there was 1 failure in which drainage persisted, the failure being due to incomplete removal of eburnated bone. The average period of drainage prior to operation was 20 weeks; after operation it was 3½ weeks. Twenty-one wounds were healed completely at the time of first inspection—usually from 10 to 15 days after operation.

Obliteration of the defect with an iliac graft was done when the anterior surface of the tibia, the radial styloid, and the calcaneus were covered only by integument, fascia, and ligamentous and tendinous structures, and muscle tissue was not available for a transplant.

The procedure in this second group, which accounted for 31 per cent of the cases in this series, was

complete excision of all infected and avascular tissue as in the first group. The bone defect was lightly filled with gauze dressings wrapped around either a Dakin tube or male catheter which extended through the gauze dressing and cast. Through this, from 2 to 4 c.c. of penicillin solution, containing 250 units per cubic centimeter, were instilled 4 times during the 24 hours, and 25,000 units were administered intramuscularly every 3 hours. After from 7 to 10 days, according to the size of the defect, the wound was inspected and the defect was always found to be covered with a thin layer of healthy granulation tissue.

A second operation was performed the next day. The appropriate iliac crest was prepared in the usual manner and small cancellous chips, approximately 4 cm. long, 1 cm. wide, and 3 cm. thick, were removed and the cortical bone was discarded. The iliac wound was closed before the recipient site was exposed, in order to prevent any cross contamination. The granulating defect was thoroughly and gently irrigated with from 1 to 2 liters of normal saline solution, and the surrounding skin was prepared with ether, alcohol, and merthiolate, care being taken to get none in the recipient site. The grafts were then "shingled" or "bricked" into place so as



to fill the defect. The wound was closed, except for a small opening or vent directly over the grafts, which was maintained by a vaseline gauze wick, and the part was immobilized in plaster.

In from 3 to 6 weeks the wound was ready for secondary closure with a relaxing incision, pinch grafts, or a pedicled graft when necessary. There were 3 criteria for timing secondary or plastic closure: (1) no sinus tracts may be present; (2) healthy granulations must cover all of the graft and the recipient bone; and (3) the surrounding soft tissues must not be edematous or inflamed.

Twenty cases of chronic osteomyelitis were treated with grafts of iliac bone. Complete healing occurred within 10 weeks; in 8 cases healing required a longer period. Failure occurred in 4 cases.

VERNON C. TURNER, M.D.

Pack, G. T., and Ehrlich, H. E.: *Exarticulation of the Lower Extremities for Malignant Tumors.* *Ann. Surg.*, 1946, 123, 124: 965, 1.

Sacroiliac disarticulation or hemipelvectomy has been performed 132 times during the last 50 years. Billroth, Trendelenburg, McBurney, Wyeth, Senn, Halsted, and Brachear of Kentucky (1866) were among some of the early master surgeons who attacked this formidable operation.

The present report is comprised of 25 cases of hip joint disarticulation. Five of these were combined with deep iliac dissection, and 6 amputations were made through the sacroiliac joint (hemipelvectomy).

The indications are as follows:

1. Large malignant tumors of the soft somatic tissues of the middle and upper thigh which cannot be adequately extirpated by thigh disarticulation.
2. Malignant osseous and periosteal tumors, involving the upper end of the femur and traversing the acetabular structures.
3. Fungating ulcerated neoplasms affecting the upper thigh, buttocks, groin, and hemilateral intrapelvic tumors (these may require sacroiliac disarticulation).
4. An infected neoplastic process, such as Kaposi's hemorrhagic sarcoma.

5. Massive osteochondroma of the innominate bone, and massive plexiform neurofibroma of the upper thigh and buttocks.

In this series of 25 hip disarticulations performed by the authors, 7 were done for spindle cell sarcoma, 4 for neurogenic sarcoma, 3 each for synovium, chondrosarcoma, and melanoma, 2 for endothelial myeloma, and 1 each for rhabdomyosarcoma, reticulum cell sarcoma, and liposarcoma. Five of the operations were performed for palliation.

The preoperative considerations include correction of the electrolyte derangement, i. e., anemia, dehydration, hypoproteinemia. Elastic bandage was not recommended except in cases of melanoma when it might avert dissemination of the tumor cells into the blood stream. Antiseptic sprays and dressings, débridement of infected and necrotic tissue, and daily surgical cleansing of the vagina may enhance

early healing and prevent wound contamination. Colonic irrigation and catheterization before surgery is also advised.

The anal orifice is closed with a pursestring suture, and the scrotum in the male is sutured to the opposite thigh. The incision runs from the pubic tubercle, extending upward and outward, to a point beyond the iliac crest. The posterior incision courses above the greater trochanter and along the infragluteal fold to the perineum, joining the anterior incision at the superior border of the symphysis pubis. The rectus abdominis is divided at its insertion and Poupart's ligament is severed at both ends. The abdominal wall is detached from its pelvic floor which is displaced upward. Care must be exercised in mobilizing the spermatic cord medially. Besides retracting the peritoneum, intestines, and bladder, one must identify the ureter and conserve its continuity. Double ligation of the external iliac vein is postponed until all the blood from the extremity has been returned to the vena cava. The pubic symphysis is exposed, skeletonized, and cut with a Gigli saw. After skeletonizing the crest, the iliopsoas muscles are severed together with the iliacus, pyramidalis, gemelli, and levator ani muscles. Transection of these muscles results in the complete exposure of the sacroiliac joint. Disarticulation of this joint is accomplished during the anterior phase of the dissection. Bleeding resulting from severance of both synchondroses may be controlled by packing. At this juncture, the patient is turned on his unaffected side and the posterior dissection is terminated by dividing the gluteal muscles, sacral ligaments, lumbar nerve trunks, and gluteal and obturator arteries. The specimen is removed.

Vigorous and troublesome bleeding may be avoided by ligation of the common iliac artery, but because of certain obvious drawbacks the authors do not recommend it routinely. Ligation of the common iliac artery is alleged to cause retardation in the healing of the flap, necrosis, and secondary infection. The large nerve trunks are injected with alcohol and ligated.

The postoperative complications were: (1) abdominal distention, (2) paresis of the urinary bladder, (3) delayed wound healing due to necrosis of the muscle tags, lymphorrhea, and fat necrosis, (4) osteomyelitis (encountered once), (5) anemia, (6) hernia (none occurred in the authors' series despite the fact that the abdominal organs were held *in situ* by skin, fascia and peritoneum).

Six case reports of sacroiliac disarticulation follow. The first patient was 16 years old; disarticulation was performed for Kaposi's hemorrhagic sarcoma of the lower extremity. The second patient was 57 years old and was subjected to disarticulation for myxoliposarcoma of the buttocks. The third patient, aged 60, was operated on for chondrosarcoma of the pubis and ischium. The fourth patient, aged 15, was operated on for a neurogenic sarcoma of the thigh and pelvic parietes. The fifth patient, aged 45, was subjected to disarticulation for periosteal fibrosar-

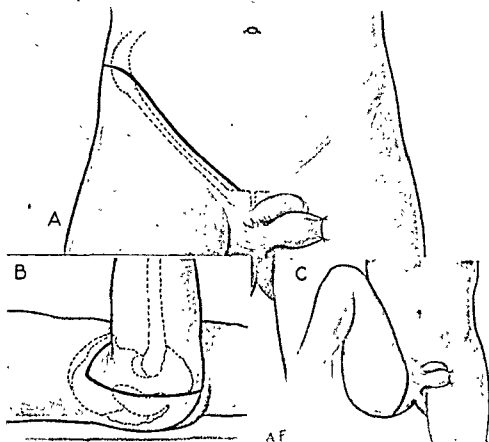


Fig. 1. Incision for sacroiliac disarticulation. A, The anterior incision extends from the pubic tubercle to beyond the iliac crest, paralleling the inguinal ligament. B, The posterior flap is outlined by carrying the lateral termination of the anterior incision downward, coursing above the greater trochanter and along the inguinal fold to the perineum. C, The anterior and posterior incisions are then joined at the superior border of the symphysis pubis. (Courtesy of J. B. Lippincott Co.)

coma of the ischium, and the last, aged 57, for extra-osseous osteogenic sarcoma of the groin and thigh.

The soft neoplasms had the best prognosis. They were neurogenic sarcoma and nonmetastasizing low-grade spindle cell sarcoma of the fascial tendon type. Of the tumors in hard tissue (bone), chondrosarcoma gave the most favorable prognosis.

One-third of all of the patients reported in the literature who have been hemipelvectomized for malignant neoplastic disease were reported to be clinically cured. Of the 6 cases reported an accurate prognosis cannot be ventured at this early postoperative period.

SAMUEL L. GOVERNALE, M.D.

Gherlinzoni, G.: The Retracted and the Short Amputation Stump of the Leg. Treatment and Prosthesis (Monconi flessi e monconi corte di gamba: trattamento e protes). *Chir. org. movim.*, 1943, 29: 37.

There were 214 cases (17 per cent) of persistent flexion at the knee joint in the author's material of 1,245 leg amputations. The more stubborn cases were those healing after prolonged periods of suppuration of the stump with extensive cicatrization of the surrounding tissues. The irreducible character of

the deformity is not so much the result of shortening of the ligaments and contraction of the capsule of the knee joint as of inflammatory infiltration or cicatricial changes in the muscles controlling the movements of the stump and knee joint. In the cases healing without suppuration, the flexed condition of the knee is likely to be corrected by physiotherapeutic measures. The flexed attitude of the knee is the natural resting or relaxed posture of the knee joint during the period of healing and might be avoided in the beginning by prophylactic bracing or splinting of the limb during the period of healing.

When the retraction has been allowed to become permanent and it resists correction by physiotherapeutic measures, operative procedures may be necessary. This is more likely to be the case when the amputation stump is short, and it is chiefly with the problem of the short stump that the author is concerned. Capsulotomy of the popliteal region of the articular capsule of the knee may be indicated; however it is not likely to succeed in the cases not correctable by physiotherapy without the addition of some type of lengthening operation on the muscles or muscle tendons, and this, together with the long postoperative period of corrective splint or cast bearing, is likely to

affect adversely the already diminished mobility of the knee joint.

In 5 of the more stubborn flexion deformities, therefore, a supracondylar osteotomy was done, and in a patient with marked osteoporosis the femur was broken manually and the bone allowed to heal with the stump in the extended position. The author thinks that this is the first time that osteotomy has been done for this condition.

The osteotomy consisted of an incision over the lateral aspect of the lower end of the femur, this bone being approached by blunt dissection between the vastus lateralis and the rectus anterior muscles. A wedge of bone is chiseled through the femur with the base of the wedge anterior, which guards against possible injury to the popliteal vessels and nerves. The limb is then immobilized in a cast for 2 months. In 1 patient in whom the amputation stump was so short as to be of no use, the idea of operation was rejected and the limb abandoned to the wearing of an end weightbearing prosthesis.

At the author's institution (*Istituto Rizzoli*, Bologna, Italy) the construction of the prosthetic apparatus for these patients has in general followed the lines laid down by Mommensen with the hinge 1 or 2 cm. above the fulcrum of the knee joint; however, some refinements have been added, including a leather cap for the stump which provides a snug fit of the stump in the leg section and a single bearing surface at the ischium. A cutout from a moving picture film shows the naturalness of the gait with this apparatus on the amputated patient. In all these short stump patients the classic operations for lengthening of the stump proved not to be necessary.

JOHN W. BRENNAN, M.D.

**Aldredge, R. H., and Thompson, T. G.: The Technique of the Syme Amputation. *J. Bone Surg.* 1946, 28: 415.**

The merits of the Syme amputation, first described over 100 years ago, have been debated more than those of any other major amputation. It was employed rather extensively by the British and Canadians in World War I. The followup on the British cases has shown the results to be so unfavorable that the surgeons and limbfitting surgeons there have condemned the operation completely, the chief cause being imperfect stumps which result from surgery done in the presence of, or too soon after, sepsis. Many Canadian surgeons, however, strongly advocate the operation whenever it is indicated. The authors do the same, basing their opinion upon the results in 75 amputations done in the Army.

The normal tough plantar skin of the heel is brought forward directly beneath the tibia where the weight of the entire body is transferred into the socket of the prosthesis without any friction against scarred areas. The stump is longer and gives better leverage and is capable of full end bearing, with or without a prosthesis. The Syme prosthesis does not extend above the knee and is easier to fit than a below the knee stump. The Syme amputation also

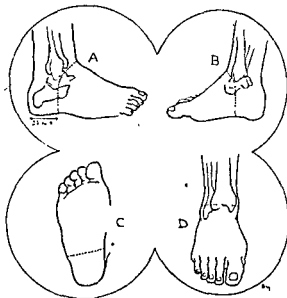


Fig. 1. The line of incision for the Syme amputation.

has many advantages over amputation through the foot, which is then too short for good function. Frequently there is muscle imbalance which permits an equinus deformity. The Syme amputation is the only amputation recommended at the ankle joint.

Unfortunately, the indications for the Syme amputation are restricted. Approximately 2 per cent of American Army amputees from World War II have had the Syme amputation. It requires greater skill on the part of the surgeon, with regard to the proper selection of cases, the operative technique, and the postoperative care than any other amputation. The bulbous ankle may be objectionable, particularly to young women.

The Syme amputation should not be performed after ligation of major vessels until sufficient time has elapsed for good collateral circulation to develop. It should not be done in the presence of sepsis, or in the presence of peripheral vascular diseases, such as thromboangiitis obliterans or arteriosclerosis; and it should not be done upon diabetic patients. Spina bifida and loss of sensation in the heel from injury or disease of the peripheral or central nervous system constitute clear cut contraindications.

Its greatest field of usefulness is in young men who are otherwise in good physical and mental condition but who have suffered the traumatic loss of the greater part of the foot. A good Syme amputation may be done if as much as 1 inch of good plantar skin is left on the heel. It may be performed for loss of the forefoot due to frostbite, trenchfoot, freezing, or any combination of these injuries, provided that sufficient time has elapsed for the local circulation to be re-established, and that persistent tenderness is not present in the soft tissue covering of the heel.

The extremity should be cleaner, surgically and bacteriologically, than for any other amputation. If

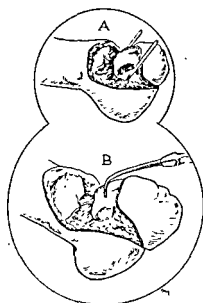


Fig. 2

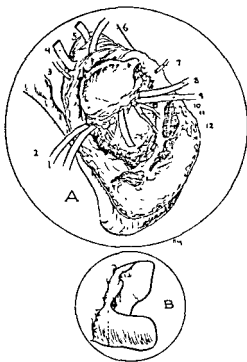


Fig. 3

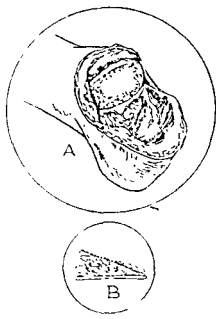


Fig. 4

Fig. 2. A, All soft tissue structures are divided in the line of the skin incision, down to the bone. The ankle is dislocated forward by cutting the talofibular and calcaneofibular ligaments from the inside of each malleolus. B, In short foot stumps the bone hook is then inserted into the talus to facilitate pulling the parts forward, while the calcaneus is dissected extraperiosteally out of the heel flap.

Fig. 3. A, After the calcaneus has been dissected out extraperiosteally, the malleoli are exposed and sawed off. 1. Peroneus brevis. 2. Peroneus longus. 3. Nerve (superficial peroneal nerve). 4. Extensor digitorum longus. 5. Anterior tibial. 6. Extensor hallucis longus. 7. Saphenous vein. 8. Posterior tibial tendon. 9. Flexor digitorum longus.

10. Medial plantar nerve. 11. Lateral plantar nerve. 12. Flexor hallucis longus. B, The saw line is placed as far distally as possible, and usually some of the articular cartilage on the end of the tibia is left (see Fig. 4A).

Fig. 4. A, All tendons and nerves, except the tendo calcaneus, are pulled down, cut at the saw line, and allowed to retract proximally. The white island in the center of the end of the tibia represents cartilage. The heel flap is débrided and all muscle, fascia, periosteum, and loose devitalized strands of tissue are removed. B, The thick edge of the heel flap is trimmed: the sharp edge of the wedge faces anteriorly, for ease of closure. The tourniquet is then removed, and the remaining open vessels are clamped and ligated. Complete hemostasis is desirable.

edema is present it is relieved by bed rest, elevation, wrapping, and, if necessary, by novocaine block of the sympathetic trunk. Cultures should be taken from all open wounds and operation postponed until the cultures are sterile.

The authors describe their technique minutely.

In general, the operation is performed in three major steps:

The first step consists of the skin incision, dislocation of the ankle, and extraperiosteal removal of the calcaneus.

The second step consists of sawing off the malleoli, cutting tendons and nerves, débriding the heel flap, and ligating the major vessels. The saw line is placed as far distally as possible. Care must be exercised in handling the posterior branches of the tibial nerve, since they are so closely associated with the corresponding vessels.

The third step consists of clamping, or ligating the small vessels until a dry field has been obtained, closing the stump, draining, and dressing.

No subcutaneous sutures are used, and the resulting suture line lies straight across the anterior aspect

of the stump. The resulting lateral projection of the skin forming dog ears is never trimmed as this might devitalize the flap. The dog ears disappear later as a result of proper use of the compression bandage. It is important never to apply the postoperative dressing with the knee in flexion. The reader is referred to the original article for more exact details.

The leg is elevated on pillows and kept elevated until the wound is healed. The first postoperative dressing is changed in 24 hours, and the drain may be removed at this time or left in place for as long as 7 days. The stitches are removed on the fourteenth day, and the foot of the bed is leveled and elevation of the extremity is discontinued, but the limb is not allowed to hang down until the end of the third week after operation. If the circulation to the heel flap is threatened during the postoperative period, novocaine blocks of the sympathetic trunk are carried out while the patient is in bed. Ordinarily a walking pylon is applied between the third and fourth weeks and the patient is permitted up with crutches for the first week, after which he usually walks with

## INTERNATIONAL ABSTRACTS OF SURGERY

full weight bearing, without support. After about 4 weeks of use of the plaster pylon a plaster mold of the stump and leg is taken for the permanent prosthesis and a second pylon is applied until the prosthesis is fitted.

In all 75 cases the immediate results were completely satisfactory to the patient and to the surgeon. No extended followup study has been possible, since the first patients in the series were operated upon only about 3 years ago.

VERNON C. TURNER, M.D.

## FRACTURES AND LESIONS

Laurence, G.: Traumatic Nerve Lesions in Children after Supracondylar Fracture of the Humerus (Lésions traumatiques des nerfs au cours des fractures supra-condyliennes de l'humerus chez l'enfant). *Rev. chir.*, Par., 1946, 65: 87, 105.

In a series of 177 cases of supracondylar fracture, 21 nerve lesions were observed. The median nerve was involved in 11 cases, the ulnar in 6, and the radial in 4.

In all cases in which the median nerve was involved the distal fragment was displaced posteriorly. Six of these cases required surgery, in 3 of these the nerve was intact macroscopically but stretched over the end of the fragment, in 2 cases the nerve was caught between the fragments, and in 1 case the nerve was bruised. Complete recovery occurred in all within from 2 to 6 months. The most constant symptom was the absence of flexion of the second and third phalanx of the index was also impaired in 5 cases the opponens pollicis was paralyzed in addition, but pronation and supination were not impaired in any case. As the median nerve courses close to the brachial vessels, the nerve lesion is often complicated by compression of the artery.

In contradistinction to paralysis of the median nerve, the symptoms in involvement of the ulnar nerve appeared only a considerable time (from 18 days to 7 months) after the fracture. The author believes that this delayed appearance of the paralysis is not due to secondary compression by the callus but to the fact that in the ulnar nerve it takes a longer time till the primary injury produces clinical symptoms. The nerve may have been injured by the trauma itself or, more probably, by forced retraction or heavy traction on a Kirschner wire. The typical claw hand position of the fourth and fifth fingers develops only after many months, if at all. The paralysis was treated by electrotherapy. Four of the 6 patients recovered completely.

In 2 of the 4 cases of paralysis of the radius, surgery was required to liberate the nerve, which in 1 case was caught between the fragments, and in the other case was compressed by the callus. Three of the 4 patients recovered completely.

It is important to differentiate between these individual nerve lesions and the ischemic paralysis due

to bruising or obstruction of the brachial artery. In the latter condition, all 3 of the nerves are involved.

WERNER M. SOLMITZ, M.D.

Deluffi, E. L.: Isolated Traumatic Luxation of the Fibula (Le lussazione traumatiche isolate del perone). *Gior. ital. chir.*, 1946, 2: 157.

The medical literature contains only 21 instances of luxation at the tibiofibular articulations. The case here reported is the twenty-second, which has been verified by roentgen examination. There has been 1 report of luxation at the lower tibiofibular joint and 1 of luxation at both the upper and lower articulations. All the rest have been upper joint luxations and 17 of these, including the one here reported, have been examples of anterior luxation of the fibular head. This accident has been most prevalent in young males of from 15 to 35 years of age, and has nearly always occurred in sports as the result of the long jump, that is, the result of indirectly applied forces.

The case here reported was that of a 24 year old student who was performing an exercise consisting of leaping into the air and turning about. Instead of landing upright and with both feet simultaneously, the student struck the earth with the right foot and thigh and with his body doubled up like a book. The right heel received an especially severe blow. There was a sensation of grating at the knee with severe pain, and the victim was unable to rise from the ground.

The head of the fibula was easily pushed back into place while the leg was maintained at 90 degrees flexion and the foot in internal rotation and dorsiflexion. The patient was discharged 25 days later, completely healed by means of ordinary physiotherapeutic measures.

JOHN W. BRENNAN, M.D.

## ORTHOPEDICS IN GENERAL

Niebauer, J. J.: Development of Squamous Cell Carcinomas in the Sinus Tracts of Chronic Osteomyelitis. *J. Bone Surg.*, 1946, 28: 280.

Two cases of squamous cell carcinoma, arising from epithelized, chronic sinuses of bone, were seen in the Orthopedic Division of the Department of Surgery of the Stanford University School of Medicine.

The malignant degenerative change may occur as cauliflowerlike epitheliomas arising deep within the sinus, and diagnosis may be difficult unless biopsy is done in the operating room under direct vision of the entire sinus. Malignant change develops most often between the ages of 40 and 60 years in sinuses with osteomyelitis of from 20 to 50 years' duration.

Increased foul discharge, increased pain, bleeding from a sinus, and pathological fracture are indicative of malignant change. The carcinomas tend to be well differentiated squamous cell epitheliomas with little tendency to metastasize.

Amputation is usually the best method of treatment.

VERNON C. TURNER, M.D.

Caldwell, G. A., Broderick, T. F., Jr., and Rose, R. M.: Sympathetic Block of the Stellate Ganglion. Its Applications in Orthopedic Conditions. *J. Bone Surg.*, 1946, 28: 513.

The diagnostic, prognostic, and therapeutic applications of sympathetic block to the lower extremity are well known and have been employed frequently. In contrast, regional block of the sympathetic nerves supplying the upper extremity has been neglected. Stellate block is equally applicable not only to similar conditions of the upper extremity, but to many other painful conditions as well.

The authors employed infiltration of the stellate ganglion with procaine hydrochloride in approximately 400 cases of painful orthopedic lesions in the upper extremities, from which they selected for presentation 18 cases of acute subdeltoid bursitis, 12 cases of peri-arthritis, 5 cases of myositis and fibrositis, 8 cases of hypertrophic arthritis, 5 cases of the infectious arthritis, 25 cases of pain and swelling following trauma, and 5 cases of causalgia following trauma. In each category, only those cases were chosen which had been followed up carefully.

The authors tried all the approaches described in the literature and obtained the most consistently satisfactory results from modifications of the descending infiltration technique of De Sousa Pereira.

In technique I, the patient is supine, with the head rotated to the opposite side to make the sternocleidomastoid muscle stand out. The sixth cervical vertebra is located in relation to the seventh cervical spinal process posteriorly, and to the cricoid cartilage anteriorly. The finger, inserted toward the sixth

cervical transverse process, displaces the sternocleidomastoid and the carotid sheath structures laterally, and the trachea medially. The finger is pushed in until it touches the sixth cervical transverse process or the region of origin of the scalenus anterior, and is held there. The needle is inserted directly below and parallel to the finger until it touches or approximates the transverse process.

In technique II the patient is supine. The head is turned up and away from the side to be blocked, in order to make the sternocleidomastoid muscle stand out. The sixth cervical transverse process is located as before. The sternocleidomastoid and external jugular vein are displaced anteriorly and the needle is inserted at right angles to the tip of the thumb, which is held on the posterior margin of sternocleidomastoid, anterior to the sixth cervical transverse process.

The authors conclude that in cases of recent acute lesions of the upper extremity, stellate block affords relief from pain which is almost universally gratifying. In chronic cases in which the lesions have been present until such anatomical changes as adhesions, erosion of cartilage, or aberrant calcification have supervened, only transitory relief from pain can be obtained and adjunctive physical therapy should be employed. The range of physical therapy tolerated is in direct proportion to the relief of pain afforded by stellate block; and in cases showing definite but transient improvement, it may be well to consider blocking with more noxious chemicals, such as alcohol derivatives, or even employing sympathectomy.

RUDOLPH S. REICH, M.D.

# SURGERY OF THE BLOOD AND LYMPH SYSTEMS

## BLOOD VESSELS

Chetverikov, H. C.: Concerning Vasospastic Disease (Morbus vaso-spasticus). *Trachebnoe Delo*, 1946, No. 1-2, p. 22.

Intermittent attacks of pain, characterized by disturbances of the blood vascular system, have been classified into various symptomatic groups, which have been discussed as true diseases, each demanding its own method of treatment.

The author discusses the evidence for the common vasospastic origin of such divergent manifestations as hemicrania, angina pectoris, crises of abdominal and renal pains, hemorrhagic brain insult, essential meningeal hemorrhage, the vasomotor Ménière's syndrome, Raynaud's disease, true epilepsy and ulcer pains, and suggests that these manifestations be placed under one group and be designated morbus vasospasticus. These conditions have previously been tentatively grouped together and ascribed to a general disturbance of the cardiovascular tonus; however, the author thinks that the basis for them may be found as much in the pathological irritability of the sensory and motor apparatus distributed in the walls of the vessels, as in the conditions of tonus of the constituent smooth muscle fibers. He agrees with other writers in that he thinks that this irritable condition acts under the influence both of the central nervous system, and of chemical irritants arriving by way of the blood stream.

The author has had the opportunity of studying a number of patients in whom 2 or more of the cited painful syndromes had developed concurrently, or in succession, and he gives 3 case reports in an attempt to emphasize the general evidence of interdependence among these different symptomatic conditions.

All of the patients were in middle life and all had a long history of cyclic, or rhythmic, attacks of migrainelike pain in the head with temporary darkening, or even momentary loss of consciousness (disturbance of the cerebral circulation). In all, these head pains were followed or preceded, at greater or lesser intervals of time, by rather typical attacks of angina pectoris, with the pains radiating to the left shoulder and hand, and all of the patients sooner or later developed painful crises in the abdomen, which in 2 instances could be controlled by heat treatments and vasodilative drugs and other more simple measures. In the third case, however, an old syphilitic with evidence of generalized arterial involvement, the abdominal crises eventuated ultimately in an acute abdomen and death. The autopsy in this instance disclosed a mural thrombus of the abdominal aorta, a fresh thrombus in the superior mesenteric artery with spotty necrosis of the small intestines, and, of course, acute peritonitis. In this corpse there were also disclosed areas of cerebral softening, and of myocardial and hepatic degeneration.

The author believes that these cases can be explained as far as the principal manifestations are concerned by the assumption of a common spastovascular disease involving various segments of the vascular system with consequent variance of the clinical manifestations.

JOHN W. BRENNAN, M.D.

Halle, J.: Preservation of the Vein in Operations for Arteriovenous Fistula. *Lancet*, Lond., 1946, 2, 85.

Although the usual operation for arteriovenous fistula has been proximal and distal ligation of both the involved artery and vein, the author finds that such a procedure is frequently followed by symptoms of venous obstruction. Patients complain of pain with dependency or heating, dependent edema, cyanosis, and engorged veins. These manifestations are exaggerated by sympathectomy.

In patients with acute arterial injury requiring ligation of a main artery, simultaneous venous ligation probably decreases the danger of gangrene. However, because of the rich collateral circulation which develops in the presence of an arteriovenous fistula, sacrifice of a main artery is well tolerated.

In a small number of cases all arterial connections of the arteriovenous fistula were severed but the vein was left intact. The authors believe that preservation of the vein resulted in less residual disability.

TIFFODORE B. MASSELL, M.D.

Leriche, R.: Thrombotic Obliteration of the Bifurcation of the Aorta (De l'oblitération thrombotique du carrefour aortique). *Lyon chir.*, 1946, 41: 5.

A syndrome is described which results from obliteration of the bifurcation of the aorta by thrombosis. The author believes that the thrombus usually begins in one common iliac artery and progresses gradually toward the aorta until, finally, both iliac arteries and the bifurcation are obliterated. In some cases the process may originate in the aorta whence it spreads down the iliac arteries. While recanalization may occur it is of no functional significance. Generally there is an intense periarteritis around the thrombosed aorta involving the lymph nodes and the distal end of the sympathetic chain. Probably the thrombosis originates at the site of an atheromatous plaque. The condition occurs most often between the ages of 45 and 60 but the author has noted the first manifestations before the age of 30.

The symptoms are of gradual onset and manifest themselves in the genitalia as well as in the lower extremities. Subjectively, the patients complain of extreme fatigability of the lower extremities rather than true intermittent claudication and they find it impossible to maintain an erection because of the diminished blood supply to the cavernous bodies. On examination the calves and feet are pale even in the upright position; there are no palpable pulses be-

low the aorta and there is a generalized atrophy of both lower extremities. Oscillometry confirms the absence of arterial pulses, although a slight vibration is often perceptible in the upper thigh. The blood pressure is slightly elevated in the upper extremities. If the patient has had any wounds anywhere in the legs or thighs they frequently will have failed to heal and instead will have formed indolent ulcers. The diagnosis can be confirmed by x-ray visualization of the aorta under pentothal anesthesia, but the author points out that this procedure is not without danger.

The disease progresses very slowly but results in gangrene after from 5 to 10 years. The gangrene is of gradual onset, is likely to be of the dry variety, and may appear simultaneously in several areas from the trochanters to the toes. It progresses slowly, is associated with intractable pain, and ends in cardiorenal failure or terminal pneumonia.

The slow progress of the disease is explained by the rich collateral circulation to the femoral vessels from the lower aorta. The termination is thought to be the result of upward extension of the thrombosis and, at times, involvement of the accompanying veins.

Treatment consists of bilateral lumbar sympathectomy and resection of the bifurcation of the aorta. In resection of the lumbar ganglia a high sympathectomy (including L1) is advocated, not only because the vasomotor supply to the collaterals through the pelvis originates at a fairly high level, but also because it is believed that a high incision is less likely to destroy any of the needed collateral vessels. Resection of the terminal aorta and the common iliac arteries may be extremely difficult because of the marked degree of periarterial scarring which accompanies this condition. While the author suggests the desirability of performing the entire operation in one stage, he notes that most often a 2 stage procedure is necessary. At times he has had to limit himself to sympathectomy alone without resection of the thrombosed arteries. However, he considers the latter procedure inadequate because it fails to halt the upward extension of the thrombosis in the aorta. When resection is carried out it should extend up to a level at which the aorta is patent. Several case reports are given in some detail. THEODORE B. MASSELL, M.D.

Frieh, P., and Morel, A.: A Case of Obliteration of the Bifurcation of the Aorta (Leriche's Syndrome) Treated by Resection of the Bifurcation (Un cas d'obliteration du carrefour aortique [syndrome de Leriche] traité par la résection du carrefour). *Lyon chir.*, 1946, 41: 27.

A case report is made of a male, 43 years old, who first manifested intermittent claudication in both legs, sensitivity to cold, diminished amplitude of pulsations (ascertained by oscillometry) and absent palpable pulses below the femoral canal. While under observation all pulsations disappeared in both lower extremities and the patient lost his sexual power completely.

At operation the terminal aorta and both common iliac arteries were found to be obliterated by an

organized thrombus. Considerable perivascular scarring was encountered around the thrombosed vessels. The bifurcation of the aorta was excised along with the second and third left lumbar sympathetic ganglia. Return of sexual function occurred within 15 days. Two months later the third right lumbar ganglion was excised.

Eighteen months later both feet were still warm, intermittent claudication was still present, but exercise tolerance was improved. The sexual function remained satisfactory.

THEODORE B. MASSELL, M.D.

Higgins, W. H.: *Periarteritis Nodosa: Clinical Manifestations and Postmortem Findings, with a Report of 6 Cases*. *South. M. J.*, 1946, 39: 453.

The clinical manifestations and laboratory findings of periarteritis nodosa are protean, depending on the organs involved and the stage of advancement. More commonly the symptoms at the onset are gradual and present the picture of sepsis of unknown origin. As the disease progresses, one's attention is drawn to certain organs or systems which contribute to the confusion, and to frequent errors in diagnosis. Fever, malaise, abdominal discomfort, dyspnea, and paresthesias are common complaints.

Specialists in different branches of medicine have reported the disease as simulating well known clinical entities ranging from obscure neurological syndromes to trichinosis or undulant fever. Laboratory studies are not particularly helpful except in a negative way, unless an eosinophilia is present. In 1939, Rachemann reported the frequent occurrence of eosinophilia, sometimes reaching a concentration of 60 to 80 per cent of the white cells. This is particularly true when asthma is a part of the symptomatology. In fact it is his conclusion that the particular symptom complex characterized by asthma of the intractable type, pain and numbness in the extremities, and an eosinophilia in the blood of at least 25 per cent, is probably periarteritis nodosa, and the prognosis is bad. A moderate to high leukocytosis is generally present.

The article deals with 6 proved cases of periarteritis nodosa, one of which is from the personal files of the author. The others are taken from the records of the Medical College of Virginia. An analysis of these 6 cases shows a remarkable similarity of complaints notwithstanding the fact that the histories were taken by different individuals of varying abilities. In practically every instance in these and other reported cases the symptomatology is so strikingly similar that one is surprised at the small percentage of correct ante mortem diagnoses. It is probably true that at least 95 per cent are recognized only by the pathologist, and many other cases are incorrectly diagnosed clinically as such, with final recovery. Unfortunately a biopsy only occasionally provides the necessary information, since the nodules are seldom accessible and a section of muscle rarely contains the specific vascular changes. In spite of a general glandular enlargement these structures only



infrequently are diagnostic, and their removal is not as a rule helpful.

The most promising material for study is the vascular nodules and skin lesions such as purpuric spots which are occasionally found. In fairness to the clinical staff it should be remembered that the usual symptoms are in no way specific and may apply equally to a large number of other clinical entities.

In the present series, the ages of the patients varied from 31 to 55, although reports on children as young as 2½ years are on record. Males are affected four times as frequently as females, and about 50 per cent of cases are found in the third and fourth decade of life. Approximately 300 cases are now in the literature and, naturally, many more are unpublished.

A composite picture of a typical case of periarteritis nodosa could be woven into the record of a young man who for several months had been suffering from loss of weight, weakness, generalized pain in the joints and abdomen, swelling of the ankles, dyspnea, and marked anemia. He would probably have some neurological manifestations such as optic atrophy, numbness of his extremities, and weakness of one or more groups of muscles. He would show evidences of cardiovascular renal disease, and his temperature would vary over a long period. His blood would show a marked anemia, leukocytosis, and possibly an eosinophilia. If, as Rachemann has pointed out, sensory disturbances are included with this syndrome, the diagnosis of periarteritis nodosa is probable. Considerable interest is being shown in the neurological manifestations. Boyd has reviewed various psychiatric disturbances presenting such syndromes as delusions of persecution, negativism, and dementia. These syndromes have been noted chiefly in the older group. Other symptom complexes have shown meningeal irritations characterized by convulsions, either generalized or jacksonian.

Three of the author's patients had spinal fluid pressures of over 200 mm. of water, 1 patient gave a history of recurring convulsions, and 2 others developed mild delirium. Not infrequently the mesenteric vessels and adrenal glands show typical vascular changes. Death occurs in at least 90 per cent of cases, most commonly as a result of hemorrhage from a viscus, from perforation in the intestine secondary to an infarct in the mesentery, or from renal failure. In this series there were 2 fatal intestinal perforations and 1 hemorrhage from a liver aneurysm.

Periarteritis nodosa, therefore, presents a multiplicity of pathological and clinical manifestations, and the condition should be considered as a possibility in every patient with obscure or generalized symptoms.

BENJAMIN GOLDMAN, M.D.

Lindsok, G. E.: *The Surgery of the Innominate Artery*. *N. England J. M.*, 1946, 235: 71.

The author has reviewed the literature on the subject of surgery of the innominate artery. The indications for, and the technique and results of opera-

tion are discussed. Eighteen cases have been added since a review by Greenough in 1929, and a total of 107 cases of ligation, excision, or suture of the innominate artery, with an operative mortality of 54 per cent, are recorded. Since 1900 there have been 61 cases, with a mortality of 31 per cent. Nineteen cases of survival after surgery for innominate aneurysm; including the case presented by the author, are tabulated. A report of this case is presented in detail.

Ligation of the innominate artery has been performed for 4 indications: (1) recent wounds of this vessel and its two major branches, 11 cases, (2) traumatic aneurysm of the innominate, subclavian, and carotid arteries, 20 cases, (3) spontaneous (usually syphilitic) aneurysm of these vessels, 75 cases, and (4) control of remote bleeding, 1 case. A table showing the indications and the results is presented.

There can be no question of the propriety of, and necessity for operation in traumatic lesions of the innominate artery and its bifurcation. The situation is urgent, and many of the patients have not survived the immediate injury, which is usually due to a gunshot, shrapnel, or stab wound.

The problem of syphilitic or nonspecific aneurysm (usually called "spontaneous aneurysm") requires more detailed consideration and evaluation of data. Practically all these patients have had diffuse arterial and complicating visceral disease. The average age in this group was 47 years. The average age in the traumatic cases was 28 years. The incidence of therapeutic failure, especially after simple ligation, was higher in the spontaneous aneurysms than in the traumatic cases. The life of a patient afflicted with such an aneurysm is usually a miserable one because of pressure symptoms, which include severe pain, dysphagia, hoarseness, and dyspnea, and there is always the ominous threat of rupture into the pleural cavity or trachea or through the skin as a terminal event.

A few reported cases with small aneurysms in the third subclavian area, because of their small size and position, the presence of brachial pain, and the absence of clinical syphilis, were reminiscent of aneurysm due to cervical rib. However, they hardly constituted a proper indication for the operation as performed, since this type of case does not have a tendency to progression and is satisfactorily managed by local surgery.

The ideal treatment of an aneurysm, whether traumatic or spontaneous, is either a Matas end-aneurysmorrhaphy or proximodistal ligation and excision of the sac. In the case of the innominate artery the Matas operation does not lend itself to practical application, and there is no record of its deliberate use. Complete isolation and excision of the sac have been accomplished in only 3 cases, in all of which the results were successful. Resort to the simpler procedure of ligation in continuity has been the rule, because of technical difficulties or the patient's condition. Proximal ligation of the innominate artery with ligation of the carotid and subcla-

vian arteries distal to the aneurysm (the so-called triple operation) has been performed more frequently than has radical excision, and the results have been better than those of proximal ligation alone.

The author notes that in 9 of 58 cases, cerebral complications are reported to have caused post-operative death, and temporary disability occurred in a few other cases. The average age in the fatal cerebral cases was 40.0 years, as compared with 42.5 years for the entire series. These facts suggest that the inherent vascular pattern is of more importance than the age factor.

Not a single case has been reported in which gangrene of the upper extremity followed ligation of the innominate artery, a fact that emphasizes the abundant collateral vascular pathways in the shoulder girdle and axilla (intercostal-subscapular). The occurrence of late ischemic pain, paresthesia, and muscular weakness in the arm, however, has occasionally been noted and quite generally disregarded from the therapeutic standpoint. Although aneurysm of the innominate artery frequently produces Horner's syndrome on the right side, there is recorded evidence in some cases that a sympathetic release with vasodilatation occurs in the vessels of the right upper extremity within 12 to 24 hours after operation.

In view of the technical difficulties connected with exposure of the innominate artery and the high mortality in the earlier cases, various indirect or simpler therapeutic approaches for aneurysm of this

artery have been devised and tried. One is the application of the wiring technique, which has been associated with uncertain results and with the complications pertaining to this method in other vessels. A second is the technique of Brasdor-Guinar, namely, ligation of the subclavian and carotid arteries distal to the aneurysmal sac. The author notes that long term cures of from 5 to 21 years have been reported with the use of this method.

Finally, innominate aneurysm has been treated by the creation of an arteriovenous fistula between the common carotid artery and the jugular vein with an end-to-end technique. Eight such cases have been reported by McCarthy. All of these cases had positive serological reactions at the time of operation. There were 2 operative deaths, one apparently due to anesthesia and the other to embolism, and 2 later deaths, one at 5 weeks from myocardial failure and the other at 4 weeks from rupture of the aneurysm. Four patients survived, 1 for more than 4 years, and 2 of them were able to resume work.

The earliest operations on the innominate artery were carried out through a cervical or supraclavicular muscle cutting incision. It seems clear that adequate and safe exposure for surgery of the innominate artery demands some type of clavicular and manubrial section or resection. A median section of the manubrium carried through to the second interspace, with section of the right clavicle in its medial third, gave adequate exposure and a good result in the author's case.

HERBERT F. THURSTON, M.D.

# SURGICAL TECHNIQUE

## OPERATIVE SURGERY AND TECHNIQUE; POSTOPERATIVE TREATMENT

Bauer, G.: Thrombosis, Early Diagnosis, and Abortive Treatment with Heparin. *Lancet*, Lond., 1946, 1: 447.

The available figures suggest that thromboembolic complications occur after about 1.6 per cent of all surgical operations, or in every sixtieth patient. Of these patients every sixth one dies of pulmonary embolism. Of the women in childbed, (about 1.2 per cent) every eightieth one develops this complication, and of these not quite every twenty-fifth one dies. Among the patients in medical wards the incidence and mortality from this condition are just as among those in the surgical wards generally. In cases of fracture or other trauma of the lower limbs thrombotic complications are particularly common, with an incidence up to 15 per cent.

The incidence and mortality seem to have remained unaltered for several decades. Now, however, a change for the better appears possible through the use of specific anticoagulative remedies.

Heparin can be used as a prophylactic, but is best employed as a remedy for already existing thrombosis. To obtain the best results the diagnosis must be made at the earliest possible stage. It now appears to be established that the process almost always begins in the deep veins of the lower leg. Diagnosis at this early stage is facilitated and confirmed by phlebography.

If intensive heparinization is instituted at this stage, with doses from 300 to 500 mgm. (from 24,000 to 70,000 international heparin units) a day according to a definite schedule, the disease is generally aborted. After from 3 to 5 days the acute symptoms usually subside, and the pulse and temperature return to normal. As a rule it is then possible to allow the patients to get up. They can leave the hospital within a few days and soon resume their work.

More advanced thrombosis accompanied by phlegmasia alba dolens responds well to the same treatment, but requires more time and larger doses for cure.

Massive pulmonary embolism reacts favorably to heparin. Large doses, administered early, prevent further deposits on the embolus, and generally carry the patient over the first critical 24 hours, after which recovery is almost as quick as in uncomplicated thrombosis.

In a series comprising 622 patients with thrombosis treated on this principle in Sweden, there were only 5 deaths. Good results have also been reported from Canada. Thus it now seems possible, with the aid of heparin, to reduce the mortality from thrombosis to under 1 per cent, as compared with the previous figures of from 16 to 20 per cent for surgical and medical cases and from 3 to 5 per cent for obstetrical cases.

In the past the period by which the stay in the hospital has been prolonged by an attack of thrombosis has been about 6 weeks. With heparin treatment it is generally no more than from 6 to 9 days.

Clinical and phlebographic studies have shown that patients surviving thrombosis develop serious after effects which have received too little attention. They all suffer permanently from swelling of the affected leg, while 9 of 10 eventually show indurative lesions on the lower leg, and 4 of 5, leg ulcers. From 80 to 90 per cent of ordinary leg ulcers seem to be caused by a deep thrombosis suffered at an earlier period. All these disorders and their social consequences can be avoided if thrombosis is treated with heparin at an early stage.

The risks associated with heparin therapy are slight. When the drug is used for the treatment of manifest thrombosis there is hardly any danger of its inducing hemorrhage. Experience up to date does not point to any contraindications.

JOSEPH GASTER, M.D.

Jorpes, J. E.: Anticoagulant Therapy in Thrombosis. *Edinburgh M. J.*, 1946, 53: 222.

The author believes that we now have effective agents, heparin and dicumarol, for the prevention of intravascular coagulation during life, and by means of them thrombosis and pulmonary embolism can be combated. He called attention to only 2 details regarding heparin, namely, its physicochemical properties and its formation by the mast cells of Ehrlich.

The author presents in tables various aspects of his study, such as the frequency of pulmonary embolism and of deaths from pulmonary embolism in cases of thrombosis from the large statistical series in the literature; the comparison between conservative (1929-1938) and heparin (1940-1945) treatment of thrombosis; the frequency of thrombosis and embolism after surgical operations, childbirth, gynecological operations, and in medical cases in 19 Swedish Clinics from 1940-1945; the stay in bed and rise in temperature of 790 patients with deep venous thrombosis who were given no special treatment nor treated with heparin, heparin and dicumarol, or with dicumarol alone; the spread of pulmonary embolism to the second leg; the progressive and post-thrombotic sequelæ in 790 cases of deep venous thrombosis given no special treatment or treatment with heparin, heparin and dicumarol, or with dicumarol alone; the post-thrombotic sequelæ after 2 to 5 years in 103 cases of deep venous thrombosis following regular heparin treatment at the Mariestad Hospital from 1940 to 1945.

These facts concerning the use of heparin in Sweden and Canada, as supplemented by the findings in conjunction with dicumarol, justify the statement that the most usual forms of thrombosis can now be effectively combated. With early diagnosis and reg-

ular treatment with an anticoagulant, there is practically no mortality from diagnosed and uncomplicated thrombosis of the leg or from pulmonary embolism which is not instantaneously fatal. Failure to prevent death or spread of the process to the thigh or other leg may in most cases, if not in all, be attributed either to neglected diagnosis or defective treatment. It is evident that the medical gymnastics and early getting up of the patient can reduce the incidence of thromboembolism. This fact has been admitted by several authors, but these factors are less reliable as therapeutic agents in cases of acute venous thrombosis or pulmonary embolism. Instead of novocain block of the lumbar ganglia suggested by Leriche and Ochsner, venous ligation with or without thrombectomy has been preferred by the many recent users. Even in the selected cases, however, anticoagulant therapy could be of value to check further thrombosis in the operative field.

Regarding the mortality rate, a great saving of human lives could be obtained if recent treatment with heparin or, if possible, with dicoumarol, is given; also, the mortality of thromboembolism could further be greatly reduced through more careful observation of the earlier signs of thrombosis. Fatal casualties are rare in clinics where due attention is paid to early diagnosis. When anticoagulant therapy is used the time in the hospital is shortened by about 1 month. An early heparin treatment prevents a considerable number of thrombotic patients from developing subsequent disabling ulcers or induration in one or both legs. **Emil C. Roberts, M.D.**

**Clarkson, P., and Lawrie, R. S.: The Management and Surgical Resurfacing of Serious Burns. *Brit. J. Surg.*, 1946, 33: 311.**

This article is based on the management of 800 serious burns, sustained in the Mediterranean theatre of combat, and the problem of skin grafting in 192 of these cases during the intermediate (healing) and late (rehabilitation) phases. Grafting was performed in all instances when the full thickness of the skin was destroyed. The intermediate phase started in the second week and comprised the preparation of the patient and of the burned area for grafting, and the application of grafts and their care until healing was complete. Surgery in the late phase was necessary only for that minority of cases in which there was functional disability from the primary cover. The ideal treatment was to cover the raw area as early as possible with new skin which met the full functional and cosmetic need of the part, but a granulating surface did not always accept a thick free graft, and a thin graft, which always contracts later, might have caused disability. Because of this, some areas were treated in 2 stages; a primary cover was provided by thin free grafts and these were later excised and replaced by thicker grafts or flaps.

Petroleum products, phosphorus, and cordite, in the order given, were the most common causes of military burns, the first causing all 13 cases which presented a total skin destruction of more than 50 per

cent of the body surface. Seventy-two per cent of the cases were found to have a full thickness loss of skin involving more than 10 per cent of the body surface; 20 per cent presented complete burns of more than one-third of the body. Almost every patient with 1,000 sq. cm. or more of raw granulating surface was constitutionally ill until the raw area was substantially reduced below this figure. Thus, the management of a seriously burned patient has 2 main aspects: (1) the metabolic problem, and (2), skin grafting as early as possible.

The initial standard local treatment (admittedly far from ideal) was gentle débridement under pentothal, followed by a dressing of sterile vaseline gauze. Serious burns travel poorly after the first 6 to 12 hours and this necessitated holding the delayed cases forward. The main purpose of early treatment is to restore the circulation, and this was done, chiefly with copious quantities of plasma. Progress was checked by means of hemoglobin, blood pressure, and pulse determinations made every 3 hours. After anemia commenced, within a week or two, transfusions were administered in amounts sufficient to maintain an average hemoglobin of between 80 and 90 per cent. Often this was difficult until the granulating surfaces were healing with grafts. Planned, palatable diets with iron and vitamin C were given.

The important thing in healing was not the size of the burned area, but the resurfacing program and the time table to which it was geared. Of fundamental importance in healing raw areas was early grafting. Early grafts took best, grew more rapidly, and the raw areas were healed sooner. It usually took from 12 to 18 days after the burn to assess the areas of full thickness destruction accurately and to excise the sloughs under anesthesia. Two days later, closely packed thin patch grafts were applied, and shortly after this the patient was healed. This was the rapid time table aimed at. Of course, in extensive burns surgical removal of the sloughs was impossible because of the blood loss and shock which followed. These patients were handled at a slower, nonoperative pace that required patience, skill, and a large ward staff.

In assessing the burn depth, it was found helpful to obtain a history as to the provocative agent, the circumstances, the duration, and the clothing. Accurate assessment, however, always required recognition of the appearance of burns of different depths. The authors arbitrarily recognize 3 chief depths of burns—epidermal, dermal, and full thickness loss—and discuss each thoroughly. Frequently, differentiation between the latter two depths was very difficult. In dermal burns, although destruction extends into the dermis, sufficient epithelial elements survive to permit spontaneous skin healing. This type of healing was unsatisfactory occasionally because of disabling contractures or persistent ulcerations and ultimately required resurfacing. Late definitive repairs formed only 10 per cent of the operations and consisted of thick dermatome sheets, postauricular Wolfe grafts, and rotation or forehead flaps.

For very large areas to be covered as quickly as possible, the authors found that multiple thin patch grafts had a 90 to 100 per cent take, even on indifferent surfaces. They reason from this that primary cover by the suspension of minced skin may become practicable. Although a "primary final" repair could be obtained by a successful sheet graft for limited areas, such a graft was followed by contractures, was harder to use and apply, and did not "take" as often as did the patch graft. Therefore, this type was seldom used except for special sites, such as flexor creases and the hands. A 50 per cent gum acacia glue was preferred to Sano extracts for fixation. Pinch grafts were condemned. If the patch grafts were closely padded and thin, the ultimate scar was not unsightly.

The authors used both, but preferred the Blair knife to the Padgett dermatome. Cyclopropane was the anesthesia of choice and pentothal was used occasionally, but only for induction because of the frequency of liver damage. In extensive burns grafting over 1,000 sq. cm. was performed at each operation, from 3 to 7 day intervals intervening between stages. Since the routine use of penicillin, streptococcal infections ceased to be a major concern after the grafts were applied. The cause of perichondritis which occurred in 5 per cent of the cases as a late complication remains unsolved and treatment is unsatisfactory. In addition to infectious and cicatricial complications, pyoderma and sunsensitivity of the healed burned skin were not uncommon.

There were 3 late deaths in the group of 192 cases, none of which was due to burns. The authors conclude that death is not inevitable in cases of burns of up to 70 per cent of the body surface, with areas of full thickness skin loss up to 5,000 sq. cm., which have thorough general treatment and prompt surgical resurfacing.

DAVID H. LYNN, M.D.

#### ANTISEPTIC SURGERY; TREATMENT OF WOUNDS AND INFECTIONS

Smith, J., and Rank, B. K.: A Case of Severe Electric Burns with an Unusual Sequence of Complications. *Brit. J. Surg.*, 1946, 33: 365.

The authors report the case of an 18 year old man in the Royal Australian Air Force who suffered extensive severe electrical burns to the left arm and both legs, and 8 days later developed an acute gangrenous cholecystitis. Amputation of the upper extremity, of both legs, and a partial cholecystectomy were performed at successive intervals on this extremely sick patient. The postoperative course was complicated by bilateral pneumonia, an aborted empyema, and abscess formation in 1 leg stump and in 1 incision site. Satisfactory recovery occurred after 3 months.

The authors thought there was a possibility that the gall bladder complication was related to the extensive burn in some manner similar to Curling's ulcer of the duodenum. Because of the discrete appearance of gangrenous patches on this gall bladder

and the common blood supply of that viscus and the duodenum, an embolic process is suggested as the cause of these rare complications of severe burns.

WAYNE CAMEBON, M.D.

Carney, H. M.: Wound Healing with Low Vitamin C Level. *Ann. Surg.*, 1946, 123: 1111.

This study concerns 100 soldiers who had been at the front in Italy on a ration of concentrated foods for at least a month. All but 2 per cent of the troops had discarded their only source of vitamin C, ascorbic acid contained in lemon powder. Their fasting plasma ascorbic acid levels, as determined by the technique of Farmer and Abt, were, in general, below the normal minimal range of from .7 to 1.0 mgm. per cent. The hospital diet was unable to raise their levels appreciably. No therapeutic doses of vitamin C were given.

Of the 100 men studied none showed clinical evidence of definite vitamin C deficiency. Sixty-eight had wounds of which 8 failed to heal (11.7%) and of this number, several showed normal plasma ascorbic acid levels. Many of these failures in healing were associated with infection and the author believed that most of them were due at first to inexperience in the closure of war wounds. Among the numerous factors responsible for the low incidence of failure reported by Crutcher (2 separations in 100 consecutive cases closed from 3 to 10 days following débridement), the following are emphasized: early and adequate débridement, use of incisions at the time of débridement that readily lend themselves to closure, proper splinting of the wounded part, early (4 to 5 day) closure of the wound in the operating room at the time of the first dressing by suture or skin graft, use of fine nonabsorbable suture material closing the skin only and without tension, the maintenance of normal blood constituents especially as regards the plasma protein, hematocrit, and hemoglobin levels, and the intelligent use of penicillin and the sulfonamides. Improvement in wound healing has come from these measures and not from fortifying the diet with vitamin C.

The author concludes that no relationship between plasma ascorbic acid levels and wound healing was observed.

DAVID H. LYNN, M.D.

Odum, C. B.: Causes of Amputations in Battle Casualties with Emphasis on Vascular Injuries. *Surgery*, 1946, 19: 567.

This report is a result of a detailed study of 1,833 amputations carried out in the Third United States Army. In no case was amputation done without consultation. All surgeons were made cognizant of the latest work on vascular repair. Conservatism was always emphasized. The main causes of loss of limb in order of frequency in World War II were: traumatic amputation, vascular injury, and gas gangrene. It is noteworthy that the fourth cause of amputation in World War I, secondary infection, has been eliminated by early adequate débridement and the use of penicillin and sulfonamides. The direct

results of mine injuries are shown—1,375 cases of lower extremity amputations as compared with 458 of the upper extremity.

Clostridial infection was encountered in 445 patients, of whom 258 came to amputation. Clostridial infections were classified as follows: (1) diffuse clostridial myositis in which amputation as far above the visible evidence of involvement as possible was performed immediately; (2) clostridial cellulitis involving only a muscle or group of muscles, in which wide incision of the localized process and excision of the devitalized tissue were sufficient; and (3) localized clostridial abscess in which incision and drainage were all that was necessary. Diffuse clostridial myositis accounted for 14 per cent of the total number of amputations.

By far the greater number of patients seen in the military hospitals of this country, who were minus an extremity, lost that member immediately when hit, or it was so badly mangled that the damage was beyond repair. This group of cases accounted for 63 per cent of all the extremities amputated.

In the group of vascular injuries the greatest salvage of extremities can be accomplished. This group borders on the traumatic group closely, but when the surgeon believed that the injury to the blood supply was the paramount lesion the injury was classified as vascular. Blood vessel injuries were the cause of amputation in 23 per cent of the cases. There were sufficient vitallium tubes and heparin available to give this nonsuture method a fair trial. Some of the procedures advocated by Blakemore and his associates are impractical for use in the field for the following reasons: (1) the recognition of injury to a major vessel by an aid man on the battlefield is impossible, and the therapy cannot be instituted by him; (2) the institution of surgical procedure in the battalion aid station, where only resuscitation has been practiced, would require the revision of the entire system of handling casualties in forward areas (since vascular injuries constitute less than 1 per cent of the total number of casualties, such a change would not be justified); (3) although the time interval between wounding and the institution of surgery has been greatly reduced in World War II, it still ranges between 6 and 12 hours, even in emergencies; (4) the preparation of fresh vein grafts was time consuming (if frozen grafts had been available this objection would have been removed); and (5) the use of heparin in battle casualties entails considerable risk, because of the frequency of multiple wounds and the danger of fatal hemorrhage.

Only the larger arteries, including the subclavian, axillary, brachial, iliac, femoral, and popliteal, were repaired. Comparing the results of repair with ligation on the same group of vessels, it was found that when the major vessel was ligated 57 per cent of the involved extremities developed gangrene, but when repair was the method of choice only 38 per cent developed gangrene. Although the repair series was much smaller, and the more favorable cases were selected for repair, it was believed that there was a

distinct advantage when repair was used. In comparing the suture (42 cases) and nonsuture (28 cases) methods of repair, it was found that the incidence of gangrene following repair was approximately 50 per cent for both groups. The Blakemore method of vein graft appeared to have a slight advantage over the other nonsuture methods used. Repair by suture remains the method of choice whenever applicable even if it means the reduction of the caliber of the vessel by as much as 50 per cent.

A comparison between the incidence of gangrene following ligation in battle casualties and comparable injuries in civilian practice shows a much higher incidence of gangrene in the former. This is true in spite of simultaneous division of the companion vein and the routine use of sympathetic blocks before and after surgery. It is believed that the major part of this difference is due to the fact that the battle casualty has had the injury for from 6 to 12 hours before he reaches a surgical unit. He is often exsanguinated, has low blood pressure, and is in shock; his tissues are anoxic. There is often hemorrhage into the fascial planes of the extremity with a resulting hematoma and pressure on the collateral circulation. Often the collateral circulation has been injured also. The disappointing results from sympathetic blocks are accounted for by these facts rather than the fact that the blocks were not well done.

JOHN L. LINQUIST, M.D.

#### Conway, H.: Anaerobic Infection and Gangrene of War Wounds in Casualties from the Philippine Islands. *Surgery*, 1946, 19: 553.

An analysis of 37 cases of anaerobic infection or gangrene complicating war injuries is presented. These cases represented 0.9 per cent of 4,040 surgical battle casualties. Following early treatment at forward stations the patients were admitted to the hospital from 5 to 21 days after injury. Thus, the analysis is concerned with the management of late complications.

The mere finding of pathogenic clostridia in a wound is not of importance. The *Clostridium welchii* was recovered from 13 per cent of the cultures made of all wound discharges from the 4,040 patients. The types and locations of wounds from which the *Clostridium welchii* was recovered show that these organisms contaminate certain wounds preponderantly. Seventy-five per cent of the wounds from which the *Clostridium welchii* was recovered were those in association with compound fractures. While fractures of the tibia and fibula made up only 13 per cent of all fractures, they accounted for 33 per cent of the compound fractures which were contaminated with the *Clostridium welchii*. Wounds of the buttock comprised only 5 per cent of all soft tissue wounds but accounted for 56 per cent of soft tissue wounds contaminated with the *Clostridium welchii*.

There were 14 patients with clostridial myositis, in 8 of whom the gangrene was limited to particular muscles, while in the remainder all the muscles of the extremity were involved in the spreading, necrotic

process. The lapse of time between injury and onset of the infection in this group averaged 10 days. Only 2 of the patients had not received penicillin continuously from the time of débridement until admission to the hospital, and only 2 patients had not had débridement under 6 hours. The chain of symptoms and findings in these patients were as follows: acute onset, very severe toxemia, severe pain at the site of injury and in the extremity distal to the point of injury, restlessness, thirst, tachycardia, fever, marked swelling of the extremity, cadaveric pallor of the skin of the extremity, and serous exudate, with or without gas bubbles from the wound. There may be a bronzed tint to the skin of the face, upper chest, and arms. Crepitation of the tissues was present in 6 patients and absent in 8. Roentgenograms showed gas in the tissues in 4 of the 8 patients who were examined by means of the x-rays. Peripheral pulses in the involved extremity were absent in 6 patients.

Operative therapy in 8 cases of localized clostridial myositis consisted of wide incision and drainage combined with excision of all the gangrenous muscle. In 2 of the 8 patients amputation was necessary. Intensive penicillin therapy was given after operation in all of the cases. It had no apparent effect on the toxemia or upon the course of the fever. Gas gangrene antitoxin was given to 6 patients after operation and discontinued on the fourth day because of severe urticaria. One patient died in toxemia following a long illness complicated by hemorrhage from the wound and gangrenous cholecystitis. Seven recovered following radical excision of muscle groups.

In 6 patients there was clostridial myositis in all the muscles of an extremity. All had been treated with penicillin from the time of injury until the onset of the disease. These were patients in whom there was an abrupt onset of signs and symptoms. The leucocyte count was extremely high. Four patients recovered following amputation, while 2 patients developed severe toxemia and died. The mortality rate in these 14 cases of clostridial myositis was 21.4 per cent.

There were 23 cases of anaerobic cellulitis. These did not include cases of localized abscess from which pathogenic clostridia were recovered. Anaerobic cellulitis was characterized by the gradual onset of diffuse edema of the subcutaneous and areolar tissues. Muscles were not involved. The average lapse of time between injury and onset of the complication was 15 days. All of these patients were pale, toxic, and febrile. They did not complain of pain, and their temperatures were not high. Penicillin had been given to 18 patients. On admission their casts were stained with blood and pus and had a foul smell. The usual procedure was to remove the cast and to institute balanced traction. It was following the use of this necessary measure that these patients developed anaerobic cellulitis. The impression obtains that the motion of fascial planes coincident to removal of the plaster cast and the institution of traction causes the extension of latent anaerobic infection. Commonly there was grayish slough in the

depths of the wounds. Thick, dark brown or yellow pus with bubbles of gas could be expressed. There was no change in the skin or in the circulation of the extremity. Palpation revealed crepitation of tissue and there was abundant gas in the tissues as shown by the x-rays. All of these patients were treated by radical multiple incisions and drainage and the administration of penicillin. All patients in this group recovered.

Hemorrhage from the wound as the first sign of gas gangrene occurred in 6 of the 37 cases. Proximal ligation of the major artery was not effective in any of them. In 5 patients it was possible to control hemorrhage by clamp and ligation of the bleeding points. In 3 patients it was necessary to amputate the extensively damaged extremity.

Sulfadiazine had been given in adequate amounts as a prophylactic agent to 24 of the 37 patients who developed clostridial infection or gangrene. It was used after operation in the treatment of 30 of the patients. Its use produced no significant change in the flora of the wounds. The general condition of the patients did not improve following its use. There was no evidence that sulfadiazine was of value.

The fact that gas gangrene antitoxin had been given prophylactically in the forward areas to only 9 of the 37 patients indicates that surgeons are not convinced of its value. Antitoxin was given therapeutically to 8 patients with no obvious effect on the degree of toxemia.

Thirty of the 37 patients had been treated continuously with penicillin from the time of débridement until arrival at the hospital. Following radical surgery, 31 of the 37 patients were treated intensively with penicillin administered intramuscularly, while 6 patients received injections circumferentially into the muscles of the extremity proximal to the infection. The administration of penicillin had no effect on the degree of toxicity, on the course of the fever, or upon the appearance of the wound. The opinion is obtained that penicillin has no prophylactic or therapeutic value in infections and gangrene due to the *Clostridium welchii*. In all cases clinical improvement was attributed directly to radical surgery. No other measure could substitute for frequent transfusions of whole blood, which were the mainstay of postoperative management.

The opinion is advanced that incomplete débridement without dependent drainage is the most important factor contributing to the development of clostridial infection in war wounds.

JOHN L. LUNDQUIST, M.D.

## ANESTHESIA

Orton, R. H.: *Anesthesia in Thoracic Surgery*. *Current Res. Anesth.*, 1946, 25: 96.

A review of the literature relating to the physiology involved in thoracic surgery, and to the history of procedures developed to overcome various problems in the administration of an anesthetic for this type of surgery, was made.

Each unit must develop methods suited to the technical abilities and temperaments of both surgeon and anesthetist, to the equipment available, and to the types of operation to be undertaken.

From this review of the progress in thoracic surgery, it is possible to set down certain desirable features that should be fulfilled by this ideal form of anesthesia, viz.

1. The surgeon should have access to the operative area.

2. The tissues of the patient should be adequately supplied with oxygen.

3. Carbon dioxide should be efficiently eliminated.

4. The circulation should not be embarrassed by excessive mediastinal movement.

5. The spread of infected secretions to healthy lung should be prevented.

6. Postoperative atelectasis should be avoided.

7. Recovery of consciousness and cough reflex should be rapid.

8. The use of diathermy should be possible.

Inhalation anesthesia comes nearer the ideal than does spinal or intravenous anesthesia, but even here controversial matters appear, viz.,

1. There is the question as to the desirability of intubating the larynx. Removal of secretions can be performed only when a catheter is present in the larynx. Intubation protects against the dangers of laryngeal spasm.

2. The second point to be considered is positive pressure. The only indication is when a large bronchial fistula exists or is likely to appear.

3. The next controversial matter is the use of controlled respiration. Without voluntary respiration, mediastinal flap and paradoxical respiration are impossible.

4. Finally, the anesthetic agent has to be considered. Cyclopropane is preferred when controlled respiration is contemplated. The chief advantage of ether is that the anesthetic level is more easily maintained, particularly when repeated bronchial suction is necessary.

For extrapleural operations, intubation is not used because of the possible risk of spreading the infection. Controlled respiration is used if needed. Preliminary medication with a barbiturate tends to reduce cardiac irregularities.

For major intrapleural procedures, the method employed is endotracheal inhalation anesthesia with an inflated cuff. Ether-oxygen or cyclopropane-oxygen is administered by a machine capable of positive pressure of 5 to 10 mm. of mercury. Pentothal sodium induction may be used.

When secretions are copious, a catheter fitted with a self-inflating cuff is used and a gas-tight fit is obtained by bringing the catheter through a rubber diaphragm on the mask. A steep Trendelenburg position causes the secretions to gravitate to the face mask. Intermittent suction through the endotracheal catheter is used in addition.

During lobectomies, it has been found advisable periodically to inflate the lobes that are not being

removed at operation. Endobronchial anesthesia has been used for right pneumonectomies. Right endobronchial anesthesia has not been attempted because of the difficulty in avoiding occlusion of the bronchus of the right upper lobe.

During operations for the repair of diaphragmatic hernias, adequate relaxation is one of the first requirements if the abdominal route is chosen. This is obtained by spinal analgesia combined with light cyclopropane anesthesia, or by endotracheal ether-oxygen. If the transthoracic approach is used, minimum diaphragmatic movement is essential. This is best achieved with endotracheal cyclopropane anesthesia and controlled respiration. The diaphragm may be rendered immobile by blocking the phrenic nerve with local anesthetic.

The premedication depends upon whether or not the anesthetist proposes to use controlled respiration. When control is not contemplated, the premedication should be reduced to a minimum so that the respiratory center will not be further burdened. Nembutal and atropine are used to reduce vagal irritability and to lessen cardiac irregularities.

A word of warning must be given as to the amount of intravenous fluid that can be tolerated in the post-operative period. If large amounts are given there is considerable risk of pulmonary edema from overloading of the heart.

MARY FRANCES POE, M.D.

**Howkins, J., McLaughlin, C. R., and Daniel, P.: Neuronal Damage from Temporary Cardiac Arrest. *Lancet*, Lond., 1946, 1: 488.**

Examples of successful cardiac massage when the heart has stopped beating at operation are now numerous, but permanent success without cerebral damage is governed by the duration of cardiac arrest, the critical limit of which is at most 5 minutes. If this critical period has been exceeded and the heart has started again as a result of resuscitation, neuronal damage is likely to be proportionate to the duration of anoxia. The extent of this damage can be fully assessed only in those infrequent cases in which life lasts for several days or weeks after cardiac disaster.

A case of cardiac arrest in a woman, aged 32, is reported in which the duration of the cessation of heart action was computed to be from 10 to 11 minutes. The heart was successfully restarted by transabdominal massage. The patient survived for 26 days and died of pneumonia and urinary infection. During this time she showed certain neurological features associated with cerebral damage resulting from anoxemia. The electroencephalographic, pathological, and clinical pictures are described and correlated.

JOSEPH GASTER, M.D.

**Lery, S., and Conroy, L.: Prothrombin Time and Anesthesia. A Clinical Investigation on the Effects of Ether and Spinal Anesthesia on the Prothrombin Level of the Blood. *Anesthesiology*, 1946 7: 276.**

A study was undertaken to establish a relationship between the changed prothrombin level under ether



and spinal anesthesia with procaine, and the incidence of postoperative hemorrhage and postoperative embolism, respectively.

A total of 75 patients were studied. Of these, 50 had received ether anesthesia and 25, spinal anesthesia with procaine.

Prothrombin time determinations with the Smith bedside test were performed five times on each patient. The determinations were made for the first time shortly after admission of the patient to the hospital, the second time after the patient had had the full benefit of his preoperative sedation, the third time under surgical anesthesia, the fourth time in 6 hours after completed anesthesia, and the fifth time 24 hours after the completion of anesthesia.

The results show that ether markedly decreases the prothrombin time of the blood, while spinal anesthesia with procaine does not seem to exert any influence on the prothrombin time. In the group given ether, there was a 25.8 per cent decrease in the prothrombin time as compared to that on admission, and the decrease became even more pronounced (47.5 per cent) when the values of the second test were taken as the basis. In the group under spinal anesthesia, the decrease was only 1.5 per cent as compared to the admission values, and 10 per cent as compared to the values which were obtained after sedation.

The implications of these results in regard to the occurrence of postoperative emboli become clear at once, if they are compared with the findings of

other investigators who have shown that there is also an increase in the number of the circulating red blood cells and platelets and a rise in the hemoglobin values and blood viscosity, a slowing of the circulation time and a shortening of the coagulation time of the blood during ether anesthesia. All of these factors play a dominant role in the causation of thrombosis, and thus are responsible for postoperative embolism. Changes such as these apparently do not happen during spinal anesthesia. On the other hand, since spinal anesthesia does not exert any influence upon the formed elements of the circulating blood, and does not produce a decrease in the prothrombin time of the blood, the possibility of postoperative hemorrhage would appear to be much greater than in the patients given ether.

The results of the fourth and fifth tests show that there is a slow but gradual return of the prothrombin time values to normal.

The effect of drugs used as preoperative and postoperative sedation on the prothrombin time of the blood was also studied. It was found that sedation with barbiturates, notably sodium pentobarbital, causes a lowering of the prothrombin time. Furthermore, it was found that atropine, when given together with morphine, appears to neutralize the decreasing effect of morphine on the prothrombin time, while scopolamine, when given with morphine, does not seem to neutralize the action of morphine on the prothrombin time of the blood.

MARY FRANCES POE, M.D.

# PHYSICO-CHEMICAL METHODS IN SURGERY

## ROENTGENOLOGY

Howard, C.: Subdural Pneumography. *Am. J. Roent.*, 1946, 55: 710.

The author discusses subdural pneumography, which is the introduction of air into the subdural space so as to separate the brain from the skull and outline the contour of the cerebrum on x-ray films. This procedure demonstrates unknown attachments and abnormal adhesions between the cerebral cortex and the dura and skull. The localization of such attachments is important in jacksonian epilepsy and in post-traumatic cranial conditions.

The surgical technique for this examination is to make a small burr opening in the occipital region of the skull. At the same time from 30 to 60 c.c. of fluid are withdrawn by lumbar puncture to reduce the spinal fluid pressure to about 6 mm. of mercury. A small nick is made in the dura to allow air to enter the subdural space. The spinal fluid pressure rises to its original level and from 15 to 30 additional cubic centimeters of fluid are withdrawn. The dura is closed with a muscle graft. Roentgenograms of the skull are then taken without Bucky grid at a 6 foot tube film distance in various positions to demonstrate the subdural space.

On roentgenograms after air insufflation the cortex is separated from the vault of the skull by a variable space. The negative pressure produced in the subdural space and the gravitational effect on the brain produces this. The corticodural attachments can be visualized and studied. There is wide variation in the attachments. The broadened attachments contain enlarged pacchionian granulations. Under normal conditions there is no connection between the subdural and the subarachnoid spaces. The presence of subarachnoid air in some of these and in cephalographic studies suggests an arachnoidal tear or defect.

Subdural pneumography has demonstrated that the amount of fluid in the subdural space varies from time to time. The procedure of subdural pneumography opens a new field of study for variations in the support of the brain within the skull, the presence of variations of the corticodural attachments, and the presence of a variable amount of fluid in the subdural space.

FRANK L. HUSSEY, M.D.

Doss, A. K.: Translumbar Aortography; Its Diagnostic Value in Urology. *J. Urol.*, Balt., 1946, 55: 594.

During the past 5 years, the author has employed, almost routinely translumbar aortography for the diagnosis of urological conditions. The method has been described elsewhere. The opaque medium used is still the 80 per cent sodium iodide.

In the present article, attention is directed to the renal arterial system.

**Renal function.** There is no truly adequate test for renal function. It is the author's belief that an organ's function is no better than its blood supply and that, therefore, renal arteriography practically offers a visual estimation of its function. The method is of value especially in demonstrating the condition of the kidney above a completely or partially obstructed ureter. A kidney showing good blood supply may be saved, whereas the presence of poor blood supply would justify nephrectomy. The large hydronephrotic kidney and the kidney filled with a staghorn calculus have often been found by this method to be well worth saving.

**Renal neoplasia.** Renal arteriography is of little value in the diagnosis of carcinoma. In hypernephroma there is a pooling out of dye scattered in reticulated fashion throughout the neoplastic mass. The intrarenal arteries are characteristically spread out in spiderlike fashion.

**Cysts of the kidney.** Simple cysts are readily recognized due to lack or lessening of the blood supply, but multiple cysts are difficult to demonstrate.

**Retroperitoneal tumor.** The method here is of value in establishing a differential diagnosis from tumor of other structures, as for example, spleen, pancreas, etc., and in excluding or convicting the kidney.

**Renal ectopia.** The various forms of congenital and acquired renal ectopia are clearly demonstrated. The method permits a more scientific approach with respect to nephropexy.

**Renal duplication.** The diagnosis of renal duplication, suspected in the excretory or retrograde pyelogram, is made relatively simple. The reduced arterial supply of one segment of a duplicated kidney might account for the not infrequently seen pyelonephritis in such cases and might constitute a sound indication for removal of the avascular area of the kidney.

**Hypertension.** Aortography is the procedure of choice for discovering "Goldblatt hypertension." However, the removal of such a kidney fails to cure the hypertension, for the process is "fixed" also in the other kidney.

Finally, the method may be of value in demonstrating the presence of an aberrant vessel as the cause of hydronephrosis in certain obscure kidney lesions and in renal agenesis. T. LEUCUTIA, M.D.

Levitin, J.: Scout Film of the Abdomen. *Radiology*, 1946, 47: 10.

A scout film of the abdomen especially in acute abdominal conditions may yield information which is of extreme value to the surgeon.

A perforated ulcer may be recognized by the presence of free peritoneal air.

In small bowel distention one may distinguish between paralytic and mechanical ileus. In the latter the loops are greater in the vertical than in the trans-

verse diameter, are generally large, show prominent circular folds, and are subject to vigorous peristalsis as shown on serial films; the distention is confined to the small bowel, whereas a paralytic ileus results in the distention of all the intestinal loops.

Peritonitis may cause mechanical obstruction or paralytic ileus according to the circumstance. There may be an increased density between the loops due to the exudate. A plastic exudate may cause fixation of these loops. This may be recognized on vertical films by the existence of several gas-fluid lines at different levels, whereas otherwise a single gas-fluid level establishes itself. Often the properitoneal fat pad cannot be visualized in peritonitis because of infiltration by exudate.

Local inflammations may cause localized paralytic ileus in which only the adjacent loop of bowel appears to be distended.

Intra-abdominal adhesions may cause temporary (complete or incomplete) mechanical obstruction. In these cases it is important to take the films during an attack.

Acute appendicitis may cause paralytic ileus because of pain or serosal reflexes. The properitoneal fat line may become obliterated. Mechanical obstruction may develop. An abscess may displace the cecum.

Ileocolic intussusception had been recognized by the author on a scout film in 2 instances.

In an obstruction of the colon it is usually possible to differentiate between a gradually developing occlusion which results in a predominantly cecal dilatation (usually caused by carcinoma), and a sudden occlusion caused by a volvulus. In the latter the dilatation may be confined to the twisted section which then can become so large as to fill the abdomen.

There are no conclusive findings on a scout film in gangrene of the bowel.

Finally, absence of dilated bowel loops may point to urinary pathology as the cause of abdominal distress. If no calcified urinary stones are seen a pyelogram is recommended. GERHART S. SCHWARTZ, M.D.

Holmes, G. W., and Schultz, M. D.: *Supervoltage Radiation; A Review of the Cases Treated During an 8 Year Period, from 1937 to 1944, Inclusive.* *Am. J. Roentg.*, 1946, 55: 533.

The authors have analyzed their cases treated with x-radiation generated at 1,200 k.v.p. Their supervoltage unit delivered approximately 52 per cent of the surface dose at a depth of 10 cm., and the point of maximum intensity was about 2 mm. below the skin surface.

Since nearly all of the cases were incurable by standard procedures before x-ray therapy was started, the beneficial effect was evaluated on the basis of increase in life expectancy. Whenever possible, the results are compared with those obtained by older forms of treatment, especially with 200 k.v.p. radiation. The data of Nathanson and Welch (*Am. J. Cancer*, 1936, 28: 40; 1937, 31: 238, 457, 586, 593) have been used for this comparison.

One thousand eight hundred and thirty-seven patients were treated. Of this group, 7.3 per cent were discarded because they were referred back to their local doctor and no attempt was made to follow their progress. Five and three-tenths per cent were lost to observation at varying times and are counted as dead as of the date of the last observation.

The material studied includes tumors of the oral cavity (excluding the tongue and lesions posterior to the anterior pillar), 76 cases; tongue, 60 cases; nasopharynx and nasopharyngeal sinuses, 55 cases; tonsils, 38 cases; larynx, 50 cases; lungs, 152 cases; esophagus, 98 cases; stomach, 9 cases; large intestine, rectum, and anus, 33 cases; kidney, 15 cases; urethra, 6 cases; prostate, 52 cases; testicle, 40 cases; bladder, 196 cases; ovary, 89 cases; uterus, 58 cases; cervix, 424 cases; lymphoma, 99 cases; and metastatic disease from various tumors, 143 cases. In addition to these, 23 varieties of benign and malignant lesions totaling 107 cases were treated.

The authors believe that certain selected deep seated localized lesions which in the past have shown some response to high voltage radiation have responded better to supervoltage radiation. The latter seems to offer the patient a slight but definite increase in life expectancy, it makes the patient more comfortable, and it eliminates some of the unavoidably bad effects of lower voltage radiation. There was no evidence to show that a greater number of these tumors can be destroyed by this method of treatment than by other methods.

One of the greatest advantages of supervoltage therapy is the decreased likelihood of serious skin damage when an adequate tumor dose is given. Also, the number of ports required to deliver this dose is reduced. This advantage becomes of considerable importance in the cases in which a cure is expected or life expectancy will be greatly prolonged.

The authors conclude that supervoltage radiation should be encouraged in selected cases of carcinoma of the cervix, carcinoma of the bladder, carcinoma of the lung, embryoma of the testicle, carcinoma of the tonsil, localized lymphoma, Ewing's tumor, and carcinoma of the rectum. R. B. Lewis, M.D.

## MISCELLANEOUS

### CLINICAL ENTITIES—GENERAL PHYSIOLOGICAL CONDITIONS

Dart, E. E.: Effects of High Speed Vibrating Tools on Operators Engaged in the Airplane Industry. *Occup. M.* 1946, 1: 515.

Disorders of the blood vessels, nerves, muscles, and joints resulting from the occupational use of such vibrating tools as jackhammers and stone chisels have been recognized since 1911 when Loriga described certain peripheral vascular changes occurring in workers using pneumatic devices. Symptoms of temporary ischemia and numbness on exposure to cold followed by flushing, tingling, clumsiness, and decreased sensibility to pain, heat, and cold were observed. Pain was not a prominent symptom except during recovery from the vasospastic attack. Vibration was credited as being the chief causal agent and cold was believed to do no more than to initiate or maintain the response in an already damaged neurovascular system. Numerous subsequent reports had to do with the effects of work with vibrating tools, which Dart classifies into 4 main categories: (1) alteration of the vasomotor responses; (2) injuries to the nerves; (3) injuries to the soft tissue other than the blood vessels and nerves—including muscles, tendons, fascias, and ligaments, and (4) injuries to the bones and joints. These earlier reports, however, had to do with the effects of the older tools which had rates of vibration under 4,000 per minute. The present study is concerned with the effects of high speed electrical and air driven rotary polishing and burring machines which operate at rates of from 10,000 to 50,000, or more, revolutions per minute and are widely used today in the airplane industry.

In this investigation 112 of approximately 1,000 vibratory tool workers were seen because of complaints of pain, numbness, clumsiness, sensation of cold, stiffness, tingling, cramps, or weakness. For purposes of comparison, 112 vibratory tool workers without symptoms and 107 control subjects not exposed to vibration were also observed. Of the patients with complaints, more than half showed no physical changes to account for their symptoms; the remainder exhibited varying signs including swelling, erythema, cyanosis, epicritic sensory loss, atrophy, pallor, and disturbances of motion, such as the inability to tightly flex the fingers, the loss of fine movements, or weakness of grip. Nine patients showed muscle or tendon injuries, including 6 cases of trigger fingers and 3 cases of thickening of the palmar aponeurosis. Eleven patients had gross evidence of neuritis. The diagnosis of peripheral vascular disease could be established beyond reasonable doubt in only 24 patients. The primary involvement affected the fingers, hand, wrist, and forearm, but the remainder of the upper extremity was frequently involved to varying degrees.

To determine the peripheral vascular reactions the author devised a test which he believes is indicative of the state of vascular tone and at the same time is simple enough for the routine examination of large numbers of employees. This test consists of observing at 1 minute intervals the temperature changes on a stem thermometer grasped in the hand following immersion of the part for 5 seconds in water at 35°F. The patients whose temperatures so recorded did not return to the starting level after 15 minutes were arbitrarily determined to have a delayed (vasospastic) response. It was found that in 50 per cent of the control group the temperature had returned to the starting level after 6 or 7 minutes, whereas in 50 per cent of the patients and employees without symptoms the time required was from 9 to 10 minutes. At the end of 15 minutes, 16.8 per cent of the normal individuals still had temperatures below the starting level as contrasted to 33.9 per cent of the employees.

Vasospastic findings in 16.8 per cent of the normal group were similar to the findings of Naide who divided 50-called normal subjects into 2 approximately equal groups manifesting low and high vascular tone. The difference in this study and that of Naide as to the proportions of the 2 groups was thought to be due to the arbitrary selection of a standard 15 minute test period.

Workers with tools with vibration rates in excess of 10,000 per minute manifested conditions that differed from those of workers with tools operating at less than 4,000 per minute as follows: (1) symptoms appeared in a matter of days or months after exposure to high speed vibration in contrast to a matter of years after lower speed vibration; (2) pain was usually a major complaint of the high speed tool workers; (3) blanching of the fingers, characteristic in patients exposed to the lower rate of vibration, was absent in those using high speed tools; (4) degenerative bone changes were frequent after use of the older type tools, but were not found in workers using the high speed tools; (5) workers using the lower speed tools usually showed symptoms in the left hand in right handed persons, but those using high speed tools usually presented symptoms in the right hand in right handed individuals; and (6) peripheral vascular disturbances were found to be in the same hand as the symptoms in the earlier reports, but were usually in both hands in individuals using high speed tools.

It is notable that not only the workers complaining of symptoms but all workers exposed to high speed vibration showed a larger percentage of vasospastic reactions than the control group. Frequently the delayed temperature response was the only abnormality that could be demonstrated. Women were found to be more susceptible to vibration effects than men. There was no correlation between

the incidence of peripheral vascular disease and the use of tobacco.

Prophylactic measures recommended are: (1) the elimination of hand work when polishing by wet sand tumbling is possible, (2) the reduction of cold by heating the work rooms and by preventing the tool exhaust from blowing on the hand, (3) the replacement of worn bearings and bent shafts so as to reduce vibration, and (4) the insulation of the tool with felt or rubber to dampen the shock. When there is evidence of injury, transfer of the employee to other work is required. Because of the 16 per cent incidence of delayed reaction in normal persons new employees should be screened, as should tool operators (particularly women), from time to time. Persons with anemia, cardiac disease, or arthritis should not be permitted to work with vibrating tools.

WAYNE CAMERON, M.D.

Erskine, C. A.: An Analysis of the Klippel-Feil Syndrome. *Arch. Path., Chic.*, 1946, 41: 269.

In 1912 Klippel and Feil described the pathological anatomy of absence of the neck in a 46 year old man. The anatomic basis of the syndrome, since known by their names, consists essentially in a congenital fusion and numerical reduction of the cervical vertebrae. Since the original description of this rare condition, most of the communications have been reports of clinical cases of a less extreme type. The 3 characteristic clinical features of the syndrome are shortness of the neck, limitation of movement of the head, and lowering of the hair line.

From the example of the Klippel-Feil syndrome presented and from the case reported in the literature it is concluded that the essential features of the cervical deformity are synostosis of 2 or more cervical vertebrae and flattening and widening of the vertebral bodies. A numerical reduction of the vertebrae is an incidental rather than an essential part of the disorder, as is spina bifida. The latter depends largely on the degree of abnormality of the vertebral bodies. There is evidence that the anomaly has a genetic basis. A number of pathological conditions which have been found in association with the osseous deformity of the syndrome receive an explanation in the light of recent observations in the field of experimental embryology.

JOSEPH GASTER, M.D.

Paxson, N. F., Golub, L. J., and Hunter, R. M.: Crush Syndrome. *J. Am. M. Ass.*, 1946, 131: 500.

Although the syndrome of urinary suppression following crushing injuries was first described in 1917, recent bombings have stimulated the most interest in this subject. In the order of occurrence, the crush syndrome is characterized by initial tissue damage, shock which may be moderate or quite severe (sometimes it is absent), oliguria or anuria, uremia, and possibly death.

Microscopic examination of the kidneys shows the tubules to contain casts and granules of blood pigment, with epithelial degeneration of the second portion and occasionally of Henle's loop. The glomeruli

remain undamaged apparently. Since the chief changes are tubular, the dilute, highly acid urine, low in urea and high in chlorides, is explained.

Several theories have been postulated to explain the renal damage: ischemia, tubular obstruction, and the release of substances which are toxic to tubular epithelium. The last of these was suggested by Young in an extensive review of obstetric hemorrhage concomitant with urinary suppression, and is believed to be the most plausible by the authors.

Three cases of crush syndrome, 1 occurring with a retroplacental hemorrhage, 1 with a ruptured uterus, and 1 with a twisted ovarian cyst, and all with oliguria are presented. All had extensive extravasation of blood into the surrounding tissue. This is the first time that this syndrome has been described with an ovarian cyst. Two patients showed minimal shock signs while 1 patient experienced severe shock although she did not die. Two recovered, but the one with the retroplacental hemorrhage succumbed on the twelfth postpartum day.

It is suggested that this syndrome is more frequent than is now recognized, and not only is worth further investigation, but may be the explanation for some previously obscure obstetric fatalities.

C. FREDERICK KITTLE, M.D.

Kemp, F. H., and Vollum, R. L.: Anaerobic Cellulitis Due to Actinomyces, Associated with Gas Production. *Brit. J. Radiol.*, 1946, 19: 248.

The authors report a case of anaerobic cellulitis in a diabetic woman, 47 years of age, which started with infection of a corn on the big toe. The infection remained localized to the toe for a month and then, 4 days before hospitalization of the patient, it spread to the dorsum of the foot, which was gangrenous at the time of admission.

In spite of intensive treatment for the diabetes and the administration of 16,000 units of penicillin intramuscularly every 3 hours, the cellulitis spread upward rapidly and reached the distal thigh within 10 days after admission.

X-ray films revealed bubbles of gas in the subcutaneous tissues of the dorsum of the foot, calf, and lower third of the thigh. Smear from the foot showed actinomyces and a culture revealed a mixed growth of the *Staphylococcus aureus*, the *Bacterium coli*, and the *Pseudomonas pyocyanea*. Amputation was done through the middle third of the thigh; the amputation stump excreted much foul smelling material on drainage, and the patient died 5 days after operation.

Cultures of the pus obtained by sterile technique from the subcutaneous tissues of the upper calf immediately after amputation yielded actinomyces, which produced gas in subculture on Robertson's meat medium. Further examination of the specimen showed that the severe purulent cellulitis was confined largely to the subcutaneous tissues; there was a little spread into the chief fascial planes, but no infiltration was seen in the muscle substance.

LILIAN DONALDSON, M.D.

Pope, C. E.: A New and Successful Closed Operative Procedure for Pilonidal Sinus; Gluteus Maximus Mobilization; A Sliding Muscle Graft Procedure. *Arch. Surg.*, 1946, 52: 701.

The author reports a closed operative procedure for pilonidal sinus, which employs a sliding gluteal muscle graft. The technical details of the operation and the surgical principles it entails are described. In a series of 130 closed operations, 92 gluteus maximus sliding grafts were successfully made. The operation is applicable in all cases of pilonidal sinus excepting those in which there is involvement of the spine or bones, and it successfully overcomes the numerous disadvantages of other types of pilonidal sinus operations, whether they be closed, open, or partially closed.

require protection; (5) a greatly increased therapeutic effect from sulfonamide and penicillin therapy by the blood stream route; and (6) the feasibility of block excision.

The initial step in the operative procedure, block excision, is illustrated in Figure 1. For closure it is sufficient, in practically all cases, to mobilize the gluteus muscle on one side. The base of the wound is palpated to determine the rolling edge of the sacrum and the gluteus attachment. An incision is made through muscle and fascia at the edge of the sacrum, following which a blunt cleavage separation, that is relatively bloodless, can be carried laterally as far as necessary for supple closure of the wound. It is then possible to cover the whole sacral and coccygeal area with a firm sliding layer of muscle

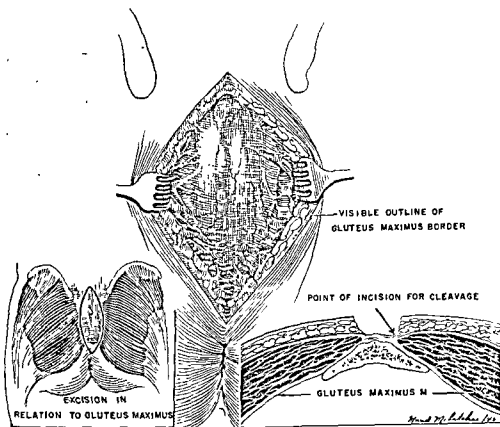


Fig. 1. Semischematic illustration demonstrating block excision of pilonidal sinus.

Mobilization of a gluteus maximus muscle flap and its employment as a graft has the following advantages: (1) adequate replacement of dead space by a muscle sliding graft; (2) freedom from tissue tension by muscle mobilization; (3) increased blood supply, increased rapidity of tissue healing and enhanced ability to combat infection by reason of the muscle graft and supple tissues, free from tension; (4) a more adequate protective pad of tissue covering an exposed defect in an otherwise relatively avascular area, where exposed sacrococcygeal bone and fascia

tissue with its overlying skin and fat. Deep closure is effected by two sets of removable wire suture, and the skin is closed with silk. Following this procedure, a pressure dressing is applied, with binding of the buttocks. No dressings are necessary until the eighth day, when the wire sutures are removed. After the tenth day gradually increased activity is permitted.

The author believes that the results in his series of cases indicate adoption of the procedure.

JOHN L. LUNDQUIST, M.D.

**Cavalcabo, G.:** Malignant Myoma; an Anatomicopathological Contribution (*Miomi maligni; contributo anatomico-patologico*). *Tumori*, Milano, 1943, 29: 267.

Two cases of malignant myoma are reported. The first was that of a 51 year old male who suffered an injury to the perineal region (on falling astraddle a tree limb), and a year later exhibited a tumefaction adherent to the end of the coccyx and protruding slightly into the rectum. The tumor was rather soft and adherent to the skin and rectal mucosa. Roentgen examination showed decalcification and alteration of the adjoining coccyx. The neoplasm was not removed but the biopsy specimen was pronounced a myoma malignum by Businco.

The second case, also pronounced a malignant degeneration of a uterine myoma by Businco, was found in the extirpated uterus of a 60 year old woman. This second tumor was not so polymorphous, undifferentiated or atypical (in contradistinction to the first) that its leiomatous character could not be recognized.

The author concludes from his own personal observations and from a study of the literature that all the various types of myoma are merely degrees of a general anaplastic process, ranging from that degree wherein the original tissue (striated or nonstriated muscle tissue) is sufficiently preserved in the tumor itself as to be recognizable (as in a rhabdomyoma or leiomyoma) to that in which polymorphous and undifferentiated tissues closely resemble the histological picture presented by the sarcomas.

JOHN W. BRENNAN, M.D.

**Papanicolaou, G. N.:** The Diagnosis of Cancer. *J. Am. M. Ass.*, 1946, 131: 372.

The apparent potentialities of studying the exfoliated cells in various secretions of the body have not been fully appreciated probably because of an inefficient and inadequate technique. Good fixation and good staining of the cancer cells are of paramount importance in this cytological method of diagnosis.

The diagnostic value of the smear test is based on the constant exfoliation of malignant neoplasms with a free surface.

Smears from the vaginal secretion, sputum, and gastric, duodenal, thoracic, and peritoneal fluid can be prepared.

Among the advantages of this method one should mention that: (1) it is simple and inexpensive, (2) it is reliable in the hands of experienced men, (3) it permits the early recognition of incipient cases or of hidden carcinomas such as carcinomas *in situ*, (4) it can be carried out on a large scale as a screening method, (5) it does not conflict in any way with other well established methods of pathological diagnoses, (6) it may eventually reveal the presence of cancer when biopsy has failed, although it may occasionally fail to show an existing cancer discovered by biopsy, and (7) it is of unique value in following up the result of operative procedures or the progress of irradiation or other therapy.

The main disadvantages are that (1) the criteria of the method are not yet clearly outlined and need to be further standardized, (2) the type and origin of the malignant cells are not always clear, (3) the grade of malignancy is not revealed, (4) no information is given as to the mitotic activity of the malignant growth or as to its relationship to the adjoining normal tissues, and (5) the average time required for the examination of a smear is somewhat longer than that required for examination of a pathological section.

JOSEPH K. NARAT, M.D.

**Hueper, W. C.:** Occupational Cancer. *J. Am. M. Ass.*, 1946, 131: 738.

The term "occupational cancer" is applied to malignant tumors which originate in persons during the course of, and as the result of, the regular and usually prolonged exercise of certain occupational activities which entail contact with some exogenous physical or chemical carcinogenic agent acting in proper intensity.

With the advent of the modern industrial era, the soot cancer of the English chimney sweeps and the lung cancers of the cobalt and uranium miners in Schneeberg and Joachimsthal were recognized as of occupational origin. The urinary bladder tumors in workers in the aniline dye industry and the cancer resulting from contact with radioactive substances and roentgen rays were added to the growing list of occupational cancers. Definite proof of carcinogenic properties has been obtained for arsenic, tar, pitch, soot, crude mineral oil, crude paraffin oil, anthracene oil, shale oil, some fuel and lubricating oils, creosote, benzene, aromatic amines, and rays from radioactive substances. The exposure time necessary for eliciting cancerous reactions in exposed workers varies greatly with the type and potency of the carcinogenic agent, the intensity of the exposure, and the susceptibility of the individual. The range is from 6 months to 3 to 4 decades, while the average time is from 5 to 15 years.

The rapid increase in the number of recognized and suspected agents causing industrial cancer which has occurred during the last 40 years makes it more likely that new and heretofore unsuspected carcinogenic agents of an industrial nature will be discovered during the coming years. Such a development is foreshadowed by the observations made recently that cancers of the liver develop in mice exposed to carbon tetrachloride, a commonly used organic solvent, and that cancers of the lung develop in mice which inhale ethyl carbonate (urethane), which is employed for anesthetic purposes.

Fourteen comprehensive recommendations for the control of occupational cancer are made. Among these is the suggestion for a nation wide survey by skilled investigators, representing management, industrial physicians, members of the Public Health Service and of departments of industrial hygiene, to determine the actual scope of the problem of industrial cancer. Lastly, an institute for the study of occupational cancer should be founded and should be

attached to or co-ordinated with one of the large existing cancer research centers in order to provide for proper integration of the results obtained by such investigations with those obtained by cancer research in general. Such an organization would serve industry for consultative and investigative purposes on matters of occupational cancer.

EDMUND A. GORVITT, M.D.

Bogart, F. B.: Leucosarcoma. *Am. J. Roentg.*, 1946, 55: 743.

Sternberg in 1908 first described a clinical entity characterized by mediastinal enlargement and a terminal blood picture classified as acute lymphatic leukemia. Study of enlarged superficial lymph nodes is reported as lymphosarcoma. At autopsy there was lymphoblastic infiltration of the thymus, and an enlargement of the liver, spleen, kidneys, and other organs.

As the thymic enlargement frequently produces the first symptom, shortness of breath, the chest roentgenogram often is the first procedure used for examination. Therefore, the radiologist should be aware of this entity so as to evaluate the x-ray findings properly and possibly suggest the clinical diagnosis before blood changes occur.

Leucosarcoma may occur at any age from 6 to 70, with one-third of the cases being found between the ages of 21 and 30. There is no sex predominance. Not all authors agree completely with Sternberg's description. Flashman and Leopold reviewed 107 cases and found only 60 with primary invasion of the thymus. Some reports in the literature describe a similar syndrome in which other glands than those in the mediastinum are primarily involved. Evans and Leucutia believe that if more patients with lymphosarcoma would live longer, they would probably show the terminal leucemic blood picture. Isaacs believes the condition is primarily a blood dyscrasia and the predominant blood cell—the leucosarcoma cell—must be differentiated from lymphoblasts and other immature blood cells by its staining characteristics.

The blood picture may be normal when first seen. The symptoms vary considerably and include: malaise, weight loss (usually slight), slight elevation of the temperature, bleeding (petechiae, hemoptysis, hematuria, epistaxis, hematemesis, gross bleeding from the mucous membranes, and retinal hemorrhages), joint pains, chest pains, cough, dyspnea, herpes, toxic erythema multiforme, diplopia, and local edema.

There is considerable diversity of opinion as to the origin of the invading cell. Sternberg believed it was a large lymphoblastic type of blood cell. Some believe the thymus is the point of origin, while Margolis and others believe the thymus is invaded along with other organs and that the cells do not represent hyperplasia of the thymic gland cells.

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Cavalcabo, G.: Malignant Myoma; an Anatomicopathological Contribution (Mioma maligni; contributo anatomico-patologico). *Tumori*, Milano, 1943, 29: 267.

Two cases of malignant myoma are reported. The first was that of a 51 year old male who suffered an injury to the perineal region (on falling astraddle a tree limb), and a year later exhibited a tumefaction adherent to the end of the coccyx and protruding slightly into the rectum. The tumor was rather soft and adherent to the skin and rectal mucosa. Roentgen examination showed decalcification and alteration of the adjoining coccyx. The neoplasm was not removed but the biopsy specimen was pronounced a myoma malignum by Businco.

The second case, also pronounced a malignant degeneration of a uterine myoma by Businco, was found in the extirpated uterus of a 60 year old woman. This second tumor was not so polymorphous, undifferentiated or atypical (in contradistinction to the first) that its leiomatous character could not be recognized.

The author concludes from his own personal observations and from a study of the literature that all the various types of myoma are merely degrees of a general anaplastic process, ranging from that degree wherein the original tissue (striated or nonstriated muscle tissue) is sufficiently preserved in the tumor itself as to be recognizable (as in a rhabdomyoma or leiomyoma) to that in which polymorphous and undifferentiated tissues closely resemble the histological picture presented by the sarcomas.

JOHN W. BRENNAN, M.D.

Papanicolaou, G. N.: The Diagnosis of Cancer. *J. Am. M. Ass.*, 1946, 131: 372.

The apparent potentialities of studying the exfoliated cells in various secretions of the body have not been fully appreciated probably because of an inefficient and inadequate technique. Good fixation and good staining of the cancer cells are of paramount importance in this cytological method of diagnosis.

The diagnostic value of the smear test is based on the constant exfoliation of malignant neoplasms with a free surface.

Smears from the vaginal secretion, sputum, and gastric, duodenal, thoracic, and peritoneal fluid can be prepared.

Among the advantages of this method one should mention that: (1) it is simple and inexpensive, (2) it is reliable in the hands of experienced men, (3) it permits the early recognition of incipient cases or of hidden carcinomas such as carcinomas *in situ*, (4) it can be carried out on a large scale as a screening method, (5) it does not conflict in any way with other well established methods of pathological diagnoses, (6) it may eventually reveal the presence of cancer when biopsy has failed, although it may occasionally fail to show an existing cancer discovered by biopsy, and (7) it is of unique value in following up the result of operative procedures or the progress of irradiation or other therapy.

The main disadvantages are that (1) the criteria of the method are not yet clearly outlined and need to be further standardized, (2) the type and origin of the malignant cells are not always clear, (3) the grade of malignancy is not revealed, (4) no information is given as to the mitotic activity of the malignant growth or as to its relationship to the adjoining normal tissues, and (5) the average time required for the examination of a smear is somewhat longer than that required for examination of a pathological section.

JOSEPH K. NARAT, M.D.

Hueper, W. C.: Occupational Cancer. *J. Am. M. Ass.*, 1946, 131: 738

The term "occupational cancer" is applied to malignant tumors which originate in persons during the course of, and as the result of, the regular and usually prolonged exercise of certain occupational activities which entail contact with some exogenous physical or chemical carcinogenic agent acting in proper intensity.

With the advent of the modern industrial era, the soot cancer of the English chimney sweeps and the lung cancers of the cobalt and uranium miners in Schneeberg and Joachimsthal were recognized as of occupational origin. The urinary bladder tumors in workers in the aniline dye industry and the cancer resulting from contact with radioactive substances and roentgen rays were added to the growing list of occupational cancers. Definite proof of carcinogenic properties has been obtained for arsenic, tar, pitch, soot, crude mineral oil, crude paraffin oil, anthracene oil, shale oil, some fuel and lubricating oils, creosote, benzene, aromatic amines, and rays from radioactive substances. The exposure time necessary for eliciting cancerous reactions in exposed workers varies greatly with the type and potency of the carcinogenic agent, the intensity of the exposure, and the susceptibility of the individual. The range is from 6 months to 3 to 4 decades, while the average time is from 5 to 15 years.

The rapid increase in the number of recognized and suspected agents causing industrial cancer which has occurred during the last 40 years makes it more likely that new and heretofore unsuspected carcinogenic agents of an industrial nature will be discovered during the coming years. Such a development is foreshadowed by the observations made recently that cancers of the liver develop in mice exposed to carbon tetrachloride, a commonly used organic solvent, and that cancers of the lung develop in mice which inhale ethyl carbonate (urethane), which is employed for anesthetic purposes.

Fourteen comprehensive recommendations for the control of occupational cancer are made. Among these is the suggestion for a nation wide survey by skilled investigators, representing management, industrial physicians, members of the Public Health Service and of departments of industrial hygiene, to determine the actual scope of the problem of industrial cancer. Lastly, an institute for the study of occupational cancer should be founded and should be

attached to or co-ordinated with one of the large existing cancer research centers in order to provide for proper integration of the results obtained by such investigations with those obtained by cancer research in general. Such an organization would serve industry for consultative and investigative purposes on matters of occupational cancer.

EDMUND A. GORVETT, M.D.

Bogart, F. B.: *Leucosarcoma. Am. J. Roentg.*, 1946, 55: 743.

Sternberg in 1908 first described a clinical entity characterized by mediastinal enlargement and a terminal blood picture classified as acute lymphatic leukemia. Biopsy of enlarged superficial lymph nodes is reported as lymphosarcoma. At autopsy there was lymphoblastic infiltration of the thymus, and an enlargement of the liver, spleen, kidneys, and other organs.

As the thymic enlargement frequently produces the first symptom, shortness of breath, the chest roentgenogram often is the first procedure used for examination. Therefore, the radiologist should be aware of this entity so as to evaluate the x-ray findings properly and possibly suggest the clinical diagnosis before blood changes occur.

Leucosarcoma may occur at any age from 6 to 70, with one-third of the cases being found between the ages of 21 and 30. There is no sex predominance. Not all authors agree completely with Sternberg's description. Flashman and Leopold reviewed 107 cases and found only 60 with primary invasion of the thymus. Some reports in the literature describe a similar syndrome in which other glands than those in the mediastinum are primarily involved. Evans and Leucutia believe that if more patients with lymphosarcoma would live longer, they would probably show the terminal leucemic blood picture. Isaacs believes the condition is primarily a blood dyscrasia and the predominant blood cell—the leucosarcoma cell—must be differentiated from lymphoblasts and other immature blood cells by its staining characteristics.

The blood picture may be normal when first seen. The symptoms vary considerably and include: malaise, weight loss (usually slight), slight elevation of the temperature, bleeding (petechiae, hemoptysis, hematuria, epistaxis, hematemesis, gross bleeding from the mucous membranes, and retinal hemorrhages), joint pains, chest pains, cough, dyspnea, herpes, toxic erythema multiforme, diplopia, and local edema.

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corrected preoperatively if possible. Clinical syndromes may be masked in old age and one must be vigilant. Frequently, the absence of fever, pain, and leucocytosis is a common finding in peritonitis, and, clinically, chest findings may be minimal even in the presence of a diffuse bronchopneumonia. Certainly, this stresses the need for adequate consultation. Elective surgery should be postponed during hot, humid weather. Coronary sclerosis per se is not a contraindication to operation if decompensation is not present. Acute occlusion after operation is infrequent.

Provided the risk is not too great, the indications for operative intervention are similar to those of any age group. In the aged, these indications generally result from complications connected with the degenerative processes, whether inflammatory, metabolic, or neoplastic.

Shock is insidious and most hazardous, and correction may be in vain. Precise technique is mandatory and frequently "staging" of an operation is well advised. Supportive measures during a prolonged procedure are imperative. A major factor in the increased success of geriatric surgery is the improvement in anesthesia. The author stresses the role which crymal anesthesia plays in amputations of the lower extremity.

Old people recover more quickly from an operation and have fewer wound disruptions than is generally realized. Early ambulation, in selected instances, reduces the *bleu noire* of geriatric surgery, namely, pneumonia, circulatory failure, and pulmonary embolism. Medicinal depression should be avoided for the same reasons. Old people often must be handled with patience and tact. Psychiatric consultation and therapy may be required. DAVID H. LYNN, M.D.

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